CAPE CANAVERAL AIR FORCE STATION,
LAUNCH COMPLEX 39, PAD A
(John F. Kennedy Space Center)
East end of Saturn Causeway
Cape Canaveral
Brevard County
Florida

HAER FL-8-11-F

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Southeast Region
Department of the Interior
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39, PAD A (John F. Kennedy Space Center)

HAER FL-8-11-F

Location:	East end of Saturn Causeway John F. Kennedy Space Center Cape Canaveral Brevard County Florida U.S.G.S. 7.5. minute False Cape, Florida, quadrangle, Universal Transverse Mercator coordinates: 17.538713.3164403 (center of the launch pad)
Date of Construction:	1963-1965; 1975-1978 (modifications for Space Shuttle Program)
Architect:	Giffels and Rossetti, Inc. of Detroit, Michigan (original); Reynolds, Smith and Hills of Jacksonville, Florida (modifications)
Builder:	Blount Brothers Corp. of Birmingham, Alabama (original); Various (modifications)
Present Owner:	National Aeronautics and Space Administration (NASA) Kennedy Space Center, FL 32899-0001
Present Use:	Aerospace Facility-vehicle launch pad
Significance:	The “Missile Launch Complex 39A Site” was originally listed in the National Register of Historic Places (NRHP) on May 24, 1973, for its association with the Man in Space Program. It was reevaluated in 1996 in the context of the Apollo Program, ca. 1961 through 1975, and on January 21, 2000, the newly defined Launch Complex 39: Pad A Historic District was listed in the NRHP. The Launch Complex 39: Pad A Historic District has since gained importance in the context of the Space Shuttle Program, ca. 1969 to 2010. As currently defined, the historic district contains twenty-one contributing resources and twenty-three noncontributing resources within its boundary. It is considered eligible for listing in the NRHP under Criteria A and C in the areas of Space Exploration and Engineering, respectively. Because it has achieved significance within the past 50 years, Criteria Consideration G applies.

The period of significance for the Launch Complex 39: Pad A Historic District, with regards to the Space Shuttle Program, is from 1980, when the first Space Shuttle vehicle arrived at the launch pad, through 2010, the designated end of the Space Shuttle Program. The Space Shuttle Program is the longest running American space program to date. Unlike the Mercury, Gemini and Apollo programs, the emphasis was on cost effectiveness and reusability, as well as the construction of a space station. The district is one of two sites at the Kennedy Space Center specially designed and constructed to launch the Space Shuttle vehicle; the other site is the Launch Complex 39: Pad B Historic District, also listed in the NRHP on January 21, 2000. It has facilitated nationally significant events associated with space travel, and has been integral to the launching of the Space Shuttle. As such, the Launch Complex 39: Pad A Historic District is of exceptional importance to the Space Shuttle Program.

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LEGEND OF ACRONYMS

ACI	Archaeological Consultants, Inc.
APU	Auxiliary Power Unit
CCAFS	Cape Canaveral Air Force Station
ECS	Environmental Control System
ET	External Tank
ET/IT	External Tank/Intertank
FSS	Fixed Service Structure
GH_2	Gaseous Hydrogen
GHe	Gaseous Helium
GOX	Gaseous Oxygen
GN_2	Gaseous Nitrogen
HER	Hoist Equipment Room
ISS	International Space Station
JSC	Johnson Space Center
KSC	Kennedy Space Center
LC	Launch Complex
LH_2	Liquid Hydrogen
LOX	Liquid Oxygen
MLP	Mobile Launcher Platform
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NRHP	National Register of Historic Places
OAA	Orbiter Access Arm
OMBUU	Orbiter Mid-Body Umbilical Unit
OMS	Orbital Maneuvering System
OV	Orbiter Vehicle
PCR	Payload Changeout Room
PGHM	Payload Ground Handling Mechanism
RCS	Reaction Control System
RSS	Rotating Service Structure
SRB	Solid Rocket Booster
SSME	Space Shuttle Main Engine
STS	Space Transportation System
U.S.	United States

HISTORICAL INFORMATION

NASA's John F. Kennedy Space Center (KSC)

The John F. Kennedy Space Center is the National Aeronautics and Space Administration's (NASA) primary center for launch and landing operations, vehicle processing and assembly, and related programs in support of manned space missions. It is located on the east coast of Florida, about 150 miles south of Jacksonville, and to the north and west of Cape Canaveral, in Brevard and Volusia Counties, and encompasses almost 140,000 acres. The Atlantic Ocean and Cape Canaveral Air Force Station (CCAFS) are located to the east, and the Indian River is to the west.

Following the launch of Sputnik I and Sputnik II, which placed Soviet satellites into Earth's orbit in 1957, the attention of the American public turned to space exploration. President Dwight D. Eisenhower initially assigned responsibility for the U.S. Space Program to the Department of Defense. The Development Operations Division of the Army Ballistic Missile Agency, led by Dr. Wernher von Braun, began to focus on the use of missiles to propel payloads, or even a man, into space. The United States successfully entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958, using a modified Jupiter missile named Juno I.[1]

With the realization that the military's involvement in the space program could jeopardize the use of space for peaceful purposes, President Eisenhower established NASA on October 1, 1958 as a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred to NASA a large portion of the Army's Development Operations Division, including the group of scientists led by Dr. Werner von Braun, and the Saturn rocket program.[2]

NASA became a resident of Cape Canaveral in 1958 when the Army Missile Firing Laboratory, then working on the Saturn rocket project under the direction of Dr. Kurt H. Debus, was transferred to the agency. Several Army facilities at CCAFS were given to NASA, including various offices and hangars, as well as Launch Complexes (LC) 5/6, 26, and 34. The Missile Firing Laboratory was renamed Launch Operations Directorate and became a branch office of the George C. Marshall Space Flight Center (MSFC) in Huntsville, Alabama. As the responsibilities of the Launch Operations Directorate grew, NASA granted the launch team increased status by making it a field center called the Launch Operations Center, and separating it from MSFC.

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[1] Charles D. Benson and William B. Faherty. *Gateway to the Moon. Building the Kennedy Space Center Launch Complex* (Gainesville, University Press of Florida, 2001), 1-2.
[2] Benson and Faherty, 15.

In May 1961, President John F. Kennedy charged NASA and the associated industries to develop a space program that would surpass the Soviet program by landing a man on the moon by the end of the decade. With the new, more powerful Saturn V rocket and the stepped-up launch schedule, it was apparent that a new launch complex was required, and CCAFS, with twenty-two launch complexes, did not have the space for new rocket facilities. Merritt Island, an undeveloped area west and north of the Cape, was selected for acquisition, and in 1961, the Merritt Island Launch Area (which, with the Launch Operations Center would become KSC) was born. In that year, NASA requested from Congress authority to purchase 80,000 acres of property, which was formally granted in 1962. The U.S. Army Corps of Engineers acted as agent for purchasing land, which took place between 1962 and 1964. NASA began gaining title to the land in late 1962, taking over 83,903.9 acres by outright purchase, which included several small towns, such as Orsino, Wilson, Heath and Audubon; many farms; citrus groves; and several fish camps. Negotiations with the State of Florida provided submerged lands, resulting in the acquisition of property identified on the original Deed of Dedication. Much of the State-provided land was located south of the Old Haulover Canal and north of the Barge Canal.

The American program to put a man in space and land on the Moon proceeded rapidly with widespread support. In November 1963, the Launch Operations Center/Merritt Island Launch Area were renamed John F. Kennedy Space Center to honor the late President.[3] The space program was organized into three phases: Mercury, Gemini, and Apollo. Project Mercury, initiated in 1958, was executed in less than five years. Begun in 1964, Project Gemini was the intermediate step toward achieving a manned lunar landing, bridging the gap between the short-duration Mercury flights and the long-duration missions proposed for the Apollo Program.[4]

Apollo, the largest and most ambitious of the manned space programs, had as its goal the landing of astronauts on the moon and their safe return to Earth. Providing the muscle to launch the spacecraft was the Saturn family of heavy vehicles. Saturn IB rockets were used to launch the early unmanned Apollo test flights and the first manned flight, Apollo 7, which carried astronauts on a ten-day earth orbital mission.[5]

Three different launch vehicles were used in Apollo: Saturn I, Saturn IB and Saturn V; and three different launch complexes were involved: LC34 and LC37 on CCAFS, and LC39 on KSC (both LC37 and LC39 are still active). Altogether, thirty-two Saturn flights occurred (seven from LC 34, eight from LC37, and seventeen from LC39, including Skylab and the Apollo-Soyuz Test Project) during the Apollo era. Of the total thirty-two, fifteen were manned, and of the seven attempted lunar landing missions, six were successful. No major launch vehicle failures of either

[3] Harry A Butowsky. *Reconnaissance Survey: Man in Space* (Washington, D.C.: National Park Service, 1981), 5; Benson and Faherty, 146.
[4] Butowsky, 5.
[5] Butowsky, 5.

Saturn IB or Saturn V occurred. There were two major command/service module failures, one on the ground (Apollo 1) and one on the way to the Moon (Apollo 13).[6]

The unmanned Apollo 4 mission, which lifted off on November 9, 1967, was the first Saturn V launch and the first launch from LC39 at KSC. On July 21, 1969, the goal of landing a man on the moon was achieved when Apollo 11 astronauts Armstrong, Aldrin, and Collins successfully executed history's first lunar landing. Armstrong and Aldrin walked on the surface of the moon for twenty-two hours and collected twenty-one kilograms of lunar material. Apollo 17 served as the first night launch in December 1972. An estimated 500,000 people saw the liftoff, which was the final launch of the Apollo Program.[7]

Skylab, an application of the Apollo Program, served as an early type of space station. With 12,700 cubic feet of work and living space, it was the largest habitable structure ever placed in orbit at the time. The station achieved several objectives: scientific investigations in Earth orbit (astronomical, space physics, and biological experiments); applications in Earth orbit (earth resources surveys); and long-duration spaceflight. Skylab 1 orbital workshop was inhabited in succession by three crews launched in modified Apollo command and service modules (Skylab 2, 3 and 4). Actively used until February 1974, Skylab 1 remained in orbit until July 11, 1979, when it re-entered Earth's atmosphere over the Indian Ocean and Western Australia after completing 34,181 orbits.[8]

The Apollo-Soyuz Test Project of July 1975, the final application of the Apollo Program, marked the first international rendezvous and docking in space, and was the first major cooperation between the only two nations engaged in manned space flight. As the first meeting of two manned spacecraft of different nations in space, first docking, and first visits by astronauts and cosmonauts into the others' spacecraft, the program was highly significant. It established workable joint docking mechanisms, taking the first steps toward mutual rescue capability of both Russian and American manned missions in space.[9]

On January 5, 1972, President Nixon delivered a speech in which he outlined the end of the Apollo era and the future of a reusable space flight vehicle, the Space Shuttle, which would provide "routine access to space." By commencing work at this time, Nixon added, "we can have the Shuttle in manned flight by 1978, and operational a short time after that."[10] The Space Task Group, previously established by President Nixon in February 1969, to recommend a future course for the U.S. Space Program, presented three choices of long-range space plans. All

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[6] NASA. *Facts: John F. Kennedy Space Center* (1994), 82.
[7] NASA, *Facts*, 86-90.
[8] NASA, *Facts*, 91.
[9] NASA, *Facts*, 96.
[10] Marcus Lindroos. "President Nixon's 1972 Announcement on the Space Shuttle." (NASA Office of Policy and Plans, NASA History Office, updated April 14, 2000).

included an Earth–orbiting space station, a space shuttle, and a manned Mars expedition.[11] Although none of the original programs presented was eventually selected, NASA implemented a program, shaped by the politics and economic realities of its time that served as a first step toward any future plans for implementing a space station.[12]

On January 5, 1972, President Richard Nixon instructed NASA to proceed with the design and building of a partially reusable space shuttle consisting of a reusable orbiter, three reusable main engines, two reusable solid rocket boosters (SRBs), and one non-reusable external liquid fuel tank (ET). NASA's administrators vowed that the shuttle would fly at least fifty times a year, making space travel economical and safe. NASA gave responsibility for developing the shuttle orbiter vehicle and overall management of the Space Shuttle Program to the Manned Spacecraft Center (now Johnson Space Center [JSC]) in Houston, based on the Center's experience. MSFC in Huntsville, Alabama was responsible for development of the Space Shuttle Main Engine (SSME), SRBs, the ET, and for all propulsion-related tasks. Engineering design support continued at JSC, MSFC and NASA's Langley Research Center, in Virginia, and engine tests were to be performed at NASA's Mississippi National Space Technology Laboratories (later named Stennis Space Center) and at the Air Force's Rocket Propulsion Laboratory in California, which later became the Santa Susana Field Laboratory.[13] NASA selected KSC as the primary launch and landing site for the Space Shuttle Program. KSC, responsible for designing the launch and recovery facilities, was to develop methods for shuttle assembly, checkout, and launch operations.[14]

On September 17, 1976, the full-scale Orbiter Vehicle (OV) prototype *Enterprise* (OV-101) was completed. Designed for test purposes only and never intended for space flight, structural assembly of this orbiter had started more than two years earlier in June 1974, at Air Force Plant 42 in Palmdale, California. Although the *Enterprise* was an aluminum shell prototype incapable of space flight, it reflected the overall design of the orbiter. As such, it served successfully in 1977, as the test article during the Approach and Landing Tests aimed at checking out both the mating with the Boeing 747 Shuttle Carrier Aircraft for ferry operations, as well as the orbiter's unpowered landing capabilities.

The first orbiter intended for space flight, *Columbia* (OV-102), arrived at KSC from the shuttle assembly facility in Palmdale, California in March 1979. Originally scheduled to lift off in late

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[11] NASA, History Office, NASA Headquarters. "Report of the Space Task Group, 1969."

[12] Dennis R. Jenkins. *Space Shuttle, The History of the National Space Transportation System. The First 100 Missions* (Cape Canaveral, Florida: Specialty Press, 2001), 99.

[13] Jenkins, 122.

[14] Linda Neuman Ezell. *NASA Historical Databook Volume III Programs and Projects 1969-1978.* The NASA History Series, NASA SP-4012, (Washington, D.C.: NASA History Office, 1988), Table 2-57; Ray A. Williamson. "Developing the Space Shuttle." *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume IV: Accessing Space* (Edited by John M. Logsdon. Washington, D.C.: U.S. Printing Office, 1999), 172-174.

1979, the launch date was delayed by problems with both the SSME components as well as the thermal protection system. *Columbia* spent 610 days in the Orbiter Processing Facility, another thirty-five days in the Vehicle Assembly Building and 105 days on LC39A before finally lifting off on April 12, 1981. Space Transportation System (STS)-1, the first orbital test flight and first Space Shuttle Program mission, ended with a landing on April 14 at Edwards Air Force Base in California. This launch demonstrated *Columbia's* ability to fly into orbit, conduct on-orbit operations, and return safely.[15] *Columbia* flew three additional test flights in 1981 and 1982, all with a crew of two. The Orbital Flight Test Program ended in July 1982, with 95 percent of its objectives completed. After the end of the fourth mission, President Ronald Reagan declared that with the next flight the Shuttle would be "fully operational."

A total of 131 Space Shuttle missions have been launched from the KSC between April 1981, and April 2010. From April 1981 until the *Challenger* (OV-099) accident in January 1986, between two and nine missions were flown yearly, with an average of four to five per year. The milestone year was 1985, when nine flights were successfully completed. The years between 1992 and 1997, were the most productive, with seven or eight yearly missions. Since 1995, in addition to its unique responsibility as the shuttle launch site, KSC also became the preferred landing site.

Over the past two decades, the Space Shuttle Program has launched a number of planetary and astronomy missions including the Hubble Space Telescope, the Galileo probe to Jupiter, Magellan to Venus, and the Upper Atmospheric Research Satellite. In addition to astronomy and military satellites, a series of Spacelab research missions were flown which carried dozens of international experiments in disciplines ranging from materials science to plant biology. Spacelab was a manned, reusable, microgravity laboratory flown into space in the rear of the Space Shuttle cargo bay. It was developed on a modular basis allowing assembly in a dozen arrangements depending on the specific mission requirements.[16] The first Spacelab mission, carried aboard *Columbia* (STS-9), began on November 28, 1983. Four Spacelab missions were flown between 1983 and 1985. Following a hiatus in the aftermath of the *Challenger* disaster, the next Spacelab mission was not launched until 1990. In total, twenty-four Space Shuttle missions carried Spacelab hardware before the program was decommissioned in 1998.[17] In addition to astronomical, atmospheric, microgravity, and life sciences missions, Spacelab was also used as a supply carrier to the Hubble Space Telescope and the Soviet space station *Mir*.

In 1995, a joint U.S./Russian Shuttle-*Mir* Program was initiated as a precursor to construction of the International Space Station (ISS). *Mir* was launched in February 1986 and remained in orbit

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[15] Jenkins, 268.
[16] NASA. *NASA Shuttle Reference Manual* (1988).
[17] STS-90, which landed on May 3, 1998, was the final Spacelab mission. NASA. "Shuttle Payloads and Related Information." KSC Factoids. Revised November 18, 2002.

until March 2001.[18] The first approach and flyaround of *Mir* took place on February 3, 1995 (STS-63); the first *Mir* docking was in June 1995 (STS-71). During the three-year Shuttle-*Mir* Program (June 27, 1995 to June 2, 1998) the Space Shuttle docked with *Mir* nine times. All but the last two of these docking missions used the Orbiter *Atlantis*. In 1995, Dr. Norman Thagard was the first American to live aboard the Russian space station. Over the next three years, six more U.S. astronauts served tours on *Mir*. The Shuttle served as a means of transporting supplies, equipment and water to the space station in addition to performing a variety of other mission tasks, many of which involved earth science experiments. It also returned experiment results and unneeded equipment. The Shuttle-*Mir* program served to acclimate the astronauts to living and working in space. Many of the activities carried out were types they would perform on the ISS.[19]

On December 4, 1999, *Endeavour* (STS-88) launched the first American-built component of the ISS into orbit. As noted by Williamson, this event marked, "at long last the start of the Shuttle's use for which it was primarily designed – transport to and from a permanently inhabited orbital space station."[20] STS-96, launched on May 27, 1999, marked the first mission to dock with the ISS. Since that time, most Space Shuttle missions have supported the continued assembly of the space station. As currently planned, ISS assembly missions will continue through the life of the Space Shuttle Program.

The Space Shuttle Program suffered two major setbacks with the tragic losses of the *Challenger* and *Columbia* on January 28, 1986, and February 1, 2003, respectively. Following the *Challenger* accident, the program was suspended, and President Ronald Reagan formed a thirteen-member commission to identify the cause of the disaster. The Rogers Commission report, issued on June 6, 1986, which also included a review of the program, concluded "that the drive to declare the Shuttle operational had put enormous pressures on the system and stretched its resources to the limit."[21] In addition to mechanical failure, the Commission noted a number of NASA management failures that contributed to the catastrophe. As a result, among the tangible actions taken were extensive redesign of the SRBs; upgrading of the Space Shuttle tires, brakes, and nose wheel steering mechanisms; the addition of a drag chute to help reduce speed upon landing; the addition of a crew escape system; and the requirement for astronauts to wear pressurized flight safety suits during launch and landing operations. Other changes involved reorganization and decentralization of the Space Shuttle Program. NASA moved the management of the program from JSC to NASA Headquarters, with the aim of preventing

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[18] Tony Reichhardt (editor). *Space Shuttle, The First 20 Years* (Washington, D.C.: Smithsonian Institution, 2002), 85.

[19] Judy A. Rumerman, with Stephen J. Garber. *Chronology of Space Shuttle Flights 1981-2000*. HHR-70 (Washington, D.C.: NASA History Division, Office of Policy and Plans, October 2000), 3.

[20] Williamson, 191.

[21] Columbia Accident Investigation Board. *Report Volume I* (August 2003), 25.

communication deficiencies.[22] Experienced astronauts were placed in key NASA management positions, all documented waivers to existing flight safety criteria were revoked and forbidden, and a policy of open reviews was implemented.[23] In addition, NASA adopted a Space Shuttle flight schedule with a reduced average number of launches, and discontinued the long-term practice of launching commercial and military payloads.[24] The launch of *Discovery* (STS-26) from LC39B on September 29, 1988, marked a Return to Flight after a thirty-two-month hiatus in manned spaceflight following the *Challenger* accident.

In the aftermath of the 2003 *Columbia* accident, a seven month investigation ensued, concluding with the findings of the Columbia Accident Investigation Board, which determined that both technical and management conditions accounted for the loss of the orbiter and crew. According to their Report, the physical cause of the accident was a breach in the thermal protection system on the leading edge of the left wing, caused by a piece of insulating foam, which separated from the ET after launch and struck the wing.[25] NASA spent more than two years researching and implementing safety improvements for the orbiters, SRBs and ET. Following a two-year hiatus, the launch of STS-114 on July 26, 2005, marked the first Return to Flight since the loss of *Columbia.*

On January 14, 2004, President George W. Bush outlined a new space exploration initiative in a speech given at NASA Headquarters.

> *Today I announce a new plan to explore space and extend a human presence across our solar system . . . Our first goal is to complete the International Space Station by 2010 . . . The Shuttle's chief purpose over the next several years will be to help finish assembly of the International Space Station. In 2010, the Space Shuttle – after nearly 30 years of duty – will be retired from service… .*[26]

Following the President's speech, NASA released *The Vision for Space Exploration*, which outlined the Agency's approach to the new direction in space exploration.[27] As part of this initiative, NASA will continue to use the Space Shuttle to complete assembly of the ISS. The Shuttle will not be upgraded to serve beyond 2010, and, after completing the ISS, the Space Shuttle Program will be retired.

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[22] CAIB, 101.
[23] Cliff Lethbridge. "History of the Space Shuttle Program," (2001), 4.
[24] Lethbridge, 5.
[25] CAIB, 9.
[26] The White House. "A Renewed Spirit of Discovery – The President's Vision for Space Exploration," (January 2004).
[27] NASA Headquarters. "The Vision for Space Exploration," (February 2004).

Development of KSC's LC39 and Vehicle Assembly Building Areas

Today, KSC maintains operational control over approximately 3,800 acres, all located in Brevard County. The major facilities are located within the Industrial Area, the LC39 Area, the Vehicle Assembly Building Area, and the Shuttle Landing Facility Area. The LC39 and Vehicle Assembly Building Areas were developed primarily to support launch vehicle operations and related launch processing activities. They contain the Vehicle Assembly Building, the Launch Control Center, the Orbiter Processing Facilities, the two Launch Complexes, 39A and 39B, and other support facilities.

Following completion of the Apollo-Soyuz Test Project in 1975, the facilities of KSC were modified to support the Space Shuttle Program. KSC was originally one of three possible launch sites evaluated, along with Vandenberg Air Force Base in California and the White Sands Missile Range in New Mexico. Compared with the other two locations, KSC had the advantage of approximately $1 billion in existing launch facilities. Thus, less time and money would be needed to modify existing facilities at KSC rather than to build new ones at another location. The estimate of $200 to $400 million to modify the existing KSC facilities was roughly half the cost of new construction. In addition, only KSC had abort options for a first orbit return of the low cross-range orbiter.[28]

To help keep costs down, beginning ca. 1976, KSC engineers adapted and modified many of the Apollo launch facilities to serve the needs of the Space Shuttle Program. Among the key facilities undergoing change were the Vehicle Assembly Building, the Launch Control Center, and LC39, Pads A and B. New facilities were constructed only when a unique requirement existed. The major new structures included the Shuttle Landing Facility and the Orbiter Processing Facilities. Multi-million dollar contracts for design and construction were awarded to both national and local firms, including Reynolds, Smith and Hills of Jacksonville, Florida; the Frank Briscoe Company, Inc. of East Orange, New Jersey; the Algernon Blair Industrial Contractors, Inc. of Norcross, Georgia; the Holloway Corporation of Titusville, Florida; and W&J Construction Corporation of Cocoa, Florida.

Launch Complex 39A

The "Missile Launch Complex 39A Site" was originally listed in the NRHP on May 24, 1973, for its association with the Man in Space Program. In 1996, this historic property was reevaluated in the context of the Apollo Program, ca. 1961 through 1975, and on January 21, 2000, the newly-defined Launch Complex 39: Pad A (LC39A) Historic District was listed in the NRHP. In 2006-2007, the Launch Complex 39: Pad A Historic District was included as part of the "Survey and Evaluation of NASA-owned Historic Facilities and Properties in the Context of

[28] Jenkins, 112.

the U.S. Space Shuttle Program, John F. Kennedy Space Center, Brevard County, Florida." At the time, the 2006 *Basic Information Guide* for CCAFS/KSC depicted forty-four facilities located within the historic district. Based on research and field survey, it was determined that of the forty-four facilities, twenty-one are considered contributing resources under the context of the Space Shuttle Program; twenty-three are noncontributing.[29]

Construction and Launch History

With the necessity for new launch pads for the Saturn V rockets, on February 1, 1963, the architectural/engineering firm of Giffels and Rossetti, Inc. of Detroit, Michigan, agreed to complete the design work for the two launch pads, as well as the Crawlerway.[30] The key factor in the design of the pads was the flame deflector, used to direct the "fiery exhaust of five first stage engines along the flame trench."[31] Other design considerations included the weight the launch pad would have to bear; the selection of a refractory surface material that could withstand temperatures around 3000 degrees Fahrenheit and flame velocities that reached four times the speed of sound; and ancillary features such as the terminal connection room, gas storage facilities, fuel storage facilities, and emergency egress means for astronauts and pad personnel.

Before the drawings for the launch pads were complete, construction work started at LC39A, in the form of dredging. The Gahagan Dredging Corporation from Tampa, Florida, was hired to clear the land for the Vehicle Assembly Building, as well as a barge canal for ships carrying the first two stages of the Saturn vehicle. Some of the more than 6.8 million cubic meters of "sand and shells" removed during these operations, was transported to the LC39A site in order to compress the soil there and provide fill to bring the complex to the proper elevation above mean sea level.[32] The work was finished in September 1963, around the same time that the initial drawings for the launch pad and many of the ancillary facilities were completed.[33]

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[29] Appendix A has a list of all resources within the district boundaries and under what historic context they are considered contributing. It should be noted that ten structures listed under the January 2000 nomination have since been demolished. ACI, Inc. "Survey and Evaluation of NASA-owned Historic Facilities and Properties in the Context of the U.S. Space Shuttle Program, John F. Kennedy Space Center, Brevard County, Florida." November 2007. On file, ACI, Sarasota.

[30] The Crawlerway is the special track used by the Crawler Transporter to carry the Mobile Launcher with the assembled Apollo spacecraft, or, presently, the Mobile Launcher Platform with the assembled Space Shuttle vehicle, to the launch pad.

[31] Benson and Flaherty, 235.

[32] Benson and Flaherty, 249-250.

[33] Benson and Flaherty, 250; Giffels and Rossetti, Inc., Detroit. "Complex 39, Volume II, Launch Pad 'A' Support Area." September 1963. Engineering Documentation Center, Kennedy Space Center, Sheet 2001; Giffels and Rossetti, Inc., Detroit. "Complex 39, Volume III, Launch Pad 'A'." September 1963. Engineering Documentation Center, Kennedy Space Center, Sheet 3000.

In November 1963, the joint venture of Blount Brothers Construction Company of Montgomery, Alabama, and the M.M. Sundt Construction Company of Tucson, Arizona, submitted a bid of just over $19 million for the construction of LC39A, as well as ninety percent of the Crawlerway. Work began on the pad in December 1963, and the pad was ready for use by September 1965; work on the ancillary structures continued until 1968. Altogether, the facilities built consisted of the launch pad, fuel and oxidizer facilities, air intake facilities, environmental and sewage facilities, camera stations, electrical equipment buildings, a water chiller facility, an emergency egress facility, and operations offices. In the end, the total construction cost amounted to roughly $24.5 million, with approximately 120,000 cubic yards of concrete poured, combined with 8000 tons of reinforcing steel.[34]

The first official launch from LC39A was the first test flight of a Saturn V vehicle (designated Apollo 4) on November 9, 1967. Over the remainder of the Apollo Program, one additional test flight and nine manned missions were launched from LC39A. These missions included the first manned flight of a Saturn V, Apollo 8, on December 12, 1968, as well as all of the missions destined to land on the Moon, including Apollo 11, launched on July 16, 1969, as the first lunar mission, and the ill-fated Apollo 13, which launched on April 11, 1970. On May 13, 1973, LC39A served as the launch pad for the first Skylab mission, which carried the space station into orbit. This was the last flight that launched from LC39A until the Space Shuttle Program.[35]

The first drawings for the modifications to LC39A in support of the Space Shuttle Program were submitted to NASA in March 1973, by the firm of Reynolds, Smith, and Hills of Jacksonville, Florida.[36] With the exception of the six fixed pedestals which support the Mobile Launcher Platform (MLP), all of the structures on the hardstands of each pad were to be removed or relocated, while the majority of the perimeter support facilities remained in place to be refurbished and reused or simply vacated. New hypergolic fuel and oxidizer support areas were also planned for the southwest and southeast corners of the complex, respectively.

In August 1975, Blount Brothers was awarded a contract of over $18.4 million to complete portions of the LC39A modifications, as well as the conversion of one Apollo-era Mobile Launcher to a Space Shuttle MLP.[37] Part of the mobile launcher's Launch Umbilical Tower became the new Shuttle-era Fixed Service Structure (FSS). Additional new construction consisted of a Rotating Service Structure (RSS), which included a Payload Changeout Room (PCR) with a Payload Ground Handling Mechanism (PGHM); and new flame deflectors. Alterations and additions were also completed on the complex's liquid oxygen (LOX) and liquid

[34] "Complex 39's Pad A Ready for Occupancy." *Spaceport News* (4, 35), September 2, 1965, 2.
[35] The three Skylab missions that carried astronauts to the space station all launched from LC39B, as did the Apollo-Soyuz Test Project.
[36] Reynolds Smith and Hills, Jacksonville. "Modifications to Launch Pad 39A for Space Shuttle." March 1975. Engineering Documentation Center, Kennedy Space Center, Sheet V1.
[37] "KSC Starts Pad 39 Mods for Space Shuttle Launches." *Roundup* (14, 20), September 26, 1975, 4.

hydrogen (LH_2) storage and piping facilities, electrical systems, and operational intercom and television systems.

In October 1976, Algernon Blair Industrial Contractors, Inc. of Norcross, Georgia, was awarded a $1.1 million contract for the installation of Space Shuttle ground support equipment, which included piping, cabling and other equipment, as well as new environmental control system cooling towers and the new Hypergolic Fuel Facility and Hypergolic Oxydizer Facility. Six months later, the same firm received a $4.3 million contract for the construction of a sound suppression water system. On December 29, 1980, the first Space Shuttle destined to fly arrived at LC39A.[38]

On April 12, 1981, the first flight of the Space Shuttle Program, STS-1 with the Orbiter *Columbia,* launched from LC39A, carrying astronauts John Young and Robert Crippen on a two-day mission to test the performance of the vehicle. It also served as the launch pad for the next twenty-three launches, which included the first flights of the Orbiters *Challenger* (STS-6, April 4, 1983), *Discovery* (STS-16, August 30, 1984), and *Atlantis* (STS-28, October 3, 1985). These flights also included the first American woman, Sally Ride, into space (STS-7, June 18, 1983) and the first African-American, Guion Bluford, into space (STS-8, August 30, 1983). The last flight that launched from LC39A prior to the *Challenger* accident was STS-32, which lifted off on January 12, 1986.[39]

Following the accident, LC39A was placed into an inactive status for various modifications. Among the modifications were the installation of new weather protection structures to supplement the RSS; a SRB joint heater to keep the field joints at 75 degrees; improvements in temperature and humidity controls at the PCR of the RSS; upgrades to the emergency exit system, including the addition of two slidewire baskets; installation of new elevators on the RSS; and improvements to the pad communications system. These changes had just been completed at Pad B.

LC39A was reactivated in 1989 for the launch of STS-32, which was supposed to lift-off in December but was delayed until January 9, 1990. Over the next fourteen years, the two launch complexes were used jointly, with thirty-eight missions lifting-off from LC39B and forty from LC39A, including the final launch of the Space Shuttle *Columbia* on January 16, 2003. Similar to the reactivation of Space Shuttle flights following the *Challenger* accident, the second Return to Flight mission lifted-off from LC39B, on July 26, 2005. In June 2007, LC39A was again

[38] Ken Nail, Jr. and Elaine Liston. "Chronology of KSC and KSC Related Events for 1980." KHR-5, 1 March 1981, 315.
[39] Jenkins, 267,

reactivated for STS-118, which launched on June 8, 2007. Since then, all Space Shuttle missions have launched from LC39A, and all remaining flights are scheduled to as well.[40]

LC39A Functions

LC39A, with its central launch pad and circumferential support structures, serves as the facility for the final processing and preparation of the Space Shuttle vehicle for launch. Preparations for the arrival of a Space Shuttle typically begin immediately after the previous launch, when a complete wash-down of the entire pad occurs to clear the surfaces of any chemicals left by the vehicle's propellants, followed by an inspection to locate any damage that may have occurred during launch. The necessary repairs are completed, as are any general maintenance requirements.[41] After all of the work is finished, the entire pad (including the FSS, RSS, PCR, and hardstand) is air-cleaned to remove any debris, and then washed down a second time.

The fully-assembled Space Shuttle, on top of one of the three MLPs (HAER No. FL-8-11-D), is brought to the launch complex by one of the two Crawler Transporters (HAER No. FL-8-11-C) approximately one month prior to the planned launch date.[42] When it reaches the pad, the Shuttle/MLP combination is properly aligned with the six standard MLP support pedestals by the Crawler Transporter's laser docking system. The vehicle/platform is then lowered and the MLP is attached to these supports, as well as four additional pedestals that help to stiffen the platform against rebound loads. Afterwards, all ground electrical power, data and communications interfaces, and ET propellant transfer lines between the launch pad and the Space Shuttle are connected through the MLP's Tail Service Masts and validated.[43]

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[40] Jenkins 294-295, 302-303, 310-311; NASA. "Space Shuttle Mission Archives." February 2010; NASA. "NASA's Shuttle and Rocket Launch Schedule." March 26, 2010.
[41] MLP; "INSIDE Pads A and B." *Spaceport News* (41, 8), April 19, 2002, 4.
[42] A fully assembled, or "stacked," Space Shuttle vehicle includes one orbiter, two SRBs, and one ET. These components are attached to one another, and the MLP, within the VAB (HAER No. FL-8-11-B). Slovinac, Patricia. "Written Historical and Descriptive Data." *Cape Canaveral Air Force Station, Launch Complex 39, Crawler Transporter (John F. Kennedy Space Center), HAER No. FL-8-11-C.* Submitted to NPS SE Regional Office, Atlanta, Georgia, October 2009, for inclusion in the Historic American Engineering Record, Library of Congress. Slovinac, Patricia. "Written Historical and Descriptive Data." *Cape Canaveral Air Force Station, Launch Complex 39, Mobile Launcher Transporter (John F. Kennedy Space Center), HAER No. FL-8-11-D.* Submitted to NPS SE Regional Office, Atlanta, Georgia, October 2009, for inclusion in the Historic American Engineering Record, Library of Congress; Slovinac, Patricia. "Written Historical and Descriptive Data." *Cape Canaveral Air Force Station, Launch Complex 39, Vehicle Assembly Building (John F. Kennedy Space Center), HAER No. FL-8-11-B.* Submitted to NPS SE Regional Office, Atlanta, Georgia, August 2009, for inclusion in the Historic American Engineering Record, Library of Congress.
[43] Slovinac, *Mobile Launcher Platform*. The Launch Processing System, which controls all launch operations from the LCC, is linked to the Space Shuttle/MLP through the Pad Terminal Connection Room within the pad hardstand. NASA KSC. "Launch Complex 39, Pads A and B." January 1992.

Space Shuttle Processing

The propulsion, electrical power, and Environmental Control and Life Support Systems of the orbiter all undergo their final preparations for flight at the pad. When the Space Shuttle reaches the launch pad, the orbiter is missing its base heat shield carrier panels, part of its thermal protection system, because technicians need to access the orbiter's aft compartment to complete the final processing of the SSMEs. At the pad, the SSMEs are subjected to a walkdown inspection, followed by a Helium signature test to check for any systems leaks, an electrical system checkout, a ball seal leak check, and finally, a Flight Readiness Test to ensure that all of the hydraulic systems are working properly.[44] The final closeout of the aft compartment typically occurs within one week prior to launch, after the "aft confidence test," in which all aft systems are powered up to ensure everything is working properly.[45] Once the aft compartment is closed, the base heat shield carrier panels are installed, and various checkouts and systems purges are performed in preparation for propellant loading; the final SSME checkouts are conducted the day before the scheduled launch.[46] All of this work is conducted from access platforms mounted on the MLP.

Pad processing of the orbiter's Orbital Maneuvering System (OMS) and Reaction Control System (RCS), from the 107' and 207' Levels of the RSS, begins approximately one week after the vehicle's arrival. Over a period of roughly seven days, these systems undergo a propellant servicing process, which includes filling the fuel and oxidizer tanks and checking for leaks or other problems.[47] The work is accomplished through the use of the Hypergolic Umbilical System on the 107' Level comprised of two sets of identical equipment, one for the fuel and one for the oxidizer, that includes a skid for each liquid with small tanks, pumps and pipe lines; a valve complex to control the flow of the fuel or oxidizer; and both gaseous helium (GHe) and gaseous nitrogen (GN_2) purge system panels.[48] This equipment is used for processing the OMS, the aft RCS, at the 107' Level, and the forward RCS at the 207' Level within the RCS Room. This room, however, contains its own GHe and GN_2 servicing panels.

The fuel (monomethyl hydrazine) and oxidizer (nitrogen tetroxide) used in the OMS and RCS are stored in the Hypergolic Fuel Facility, to the southwest of the launch pad, and the Hypergolic

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[44] Jessica Rye. "Status Report S-052206: NASA's Space Shuttle Processing Status Report." May 22, 2006.
[45] Tracy Young. "Status Report S-062606: NASA's Space Shuttle Processing Status Report." June 26, 2006.
[46] Jessica Rye. "Status Report S05-029: NASA's Space Shuttle Processing Status Report." July 9, 2005; Jessica Rye and Bruce Buckingham. "Status Report S05-032: NASA's Space Shuttle Processing Status Report." July 12, 2005.
[47] Melissa Matthews and Jessica Rye. "Status Report S05-025: NASA's Space Shuttle Processing Status Report." June 24, 2005; Melissa Matthews and Jessica Rye. "Status Report S05-026: NASA's Space Shuttle Processing Status Report." July 1, 2005.
[48] NASA. *Space Shuttle Launch Support Equipment Data Handbook*, Engineering Development Directorate, KSC-DD-186 Revision A, March 30, 1993, 15-1. The same skids are used to hold the fuel that will be directed to the RCS Room, which only contains control panels for the monomethyl hydrazine, nitrogen tetroxide, GHe and GN_2.

Oxidizer Facility, to the southeast of the launch pad, respectively.[49] The fuel/oxidizer, located on opposite sides of the launch pad due to their explosive nature when combined, reaches the pad through a series of pipes that begin at the storage tanks. Nearby electrical equipment buildings provide the power necessary to pump the liquids from their storage facilities to the launch pad.[50]

Also serviced from the RSS are the subsystems of the orbiter's Electrical Power System: the Auxiliary Power Unit (APU)/Hydraulics system, the fuel cells, and the Power Reactant Storage and Distribution system. Pad processing of the APU/Hydraulic system occurs from the 120' Level of the RSS; the fuel for the system, however, is supplied through mobile carts, as opposed to an integrated system within the launch pad. These carts, fitted with the necessary valves and controls, are stored at the Hypergolic Fuel Facility, where they are filled with monomethyl hydrazine before being transferred to the RSS to load the APU's tanks.[51] Additional work on the APU system includes servicing the GN_2 pressurization tanks; a hot fire of the APUs to be sure all components are working properly; and a leak test. The hydraulic components of the APU undergo their own specific tests.

Approximately two days before launch, the Power Reactant Storage and Distribution system tanks, which supply reactants to the orbiter's fuel cells, are loaded with LOX and LH_2 through the Orbiter Midbody Umbilical Unit (OMBUU) platform at the 158' Level of the RSS. The OMBUU contains several flexible hoses, which feed the liquids, as well as GN_2 and GHe, to the tanks; each substance is monitored by a separate control panel.[52] The three fuel cells are activated roughly fifteen hours before launch so technicians can perform a variety of tests to check for leaks or other problems; full orbiter power switchover to fuel cells occurs roughly two or three minutes before launch.[53] Additional support equipment for the orbiter's fuel cells is located on the 155' Level of the FSS, where there are gaseous oxygen (GOX), gaseous hydrogen (GH_2), and GN_2 servicing consoles.

The final processing of the orbiter's Environmental Control and Life Support Systems is aided by the Environmental Control Systems (ECS) Room below the pad surface, as well as a GN_2/GHe panel on the 155' Level of the FSS. The ECS Room provides air to the orbiter's crew cabin, the "White Room" at the end of the Orbiter Access Arm (OAA), and the PCR, at specified temperatures, humidity, and pressures to maintain a controlled environment in these areas. Special panels on the FSS work with this supply air to conduct the final checkout procedures on the Environmental Control and Life Support Systems. These procedures include a Flash Evaporator purge, necessary to ensure the system functions properly, as well as the removal of

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[49] See page 33 for a physical description of these facilities.
[50] Pat Murphy. Personal communication with Patricia Slovinac of ACI, September 29, 2009, Kennedy Space Center.
[51] Murphy.
[52] NASA. *Space Shuttle Launch Support Equipment Data Handbook*, 16-1, 16-2; Jessica Rye and Bruce Buckingham. "Status Report S05-031: NASA's Space Shuttle Processing Status Report." July 11, 2005.
[53] NASA. *NASA Shuttle Reference Manual*. 1988.

the plugs on the Ammonia Boiler, Vacuum, and Flash Evaporator vent ports. The Cabin Air Supply Panel on the 215' Level of the FSS and a Cabin Pressurization Panel within the White Room allow technicians to perform the final 2-pounds-per-square-inch crew module pressure leak check after final crew hatch closure that ensures cabin pressurization integrity.[54]

The OAA on the 195' Level of the FSS allows pad technicians, as well as the astronauts, access to the mid-deck of the orbiter through its hatch. The hatch opens into the small room at the end of the arm, commonly referred to as the "White Room," which is maintained as a clean room area. Approximately one week prior to the launch, pad personnel install all of the equipment lockers and flight seats into the orbiter's mid-deck via the OAA.[55] Roughly three hours before lift-off, the astronauts use the arm to enter the crew compartment. The OAA is left in its extended position until the "T-9 minute" mark in the countdown to serve as an emergency escape route for the astronauts; once retracted, it can be moved back to the extended position in fifteen seconds should an emergency occur closer to lift off.[56] If such an event occurs, the astronauts exit the orbiter, walk across the OAA, and move to the west side of the FSS. There, they jump into one of seven emergency egress baskets (typically two or three per basket), and cut the rope anchor. The basket then slides down a long wire to the "Slidewire Termination Facility" near the west end of the launch complex. At this point, the astronauts exit the baskets and run into an adjacent underground bunker, where they can stay until rescue teams are able to reach them.[57]

Two extendible arms on the FSS provide processing support for the ET: the ET/Intertank (IT) Access Arm at the 215' Level and the GOX Vent Arm at the 275' Level. From the ET/IT Access Arm, pad technicians can access the intertank compartment of the ET, as well as attach all electrical and LH_2 propellant umbilicals to the orbiter and/or SRBs and their vent lines, respectively. The vented LH_2 is released through a flare stack to the northeast of the launch pad. This arm is retracted from the ET roughly five days prior to launch.[58] The GOX Vent Arm has a vent hood at its end, commonly referred to as the "beanie cap" to which heated GN_2 is pumped to warm the oxygen vapors being vented at the top of the ET from the LOX tank. This prevents ice from forming at the top of the tank, which could potentially break loose during launch and damage the orbiter. At about two-and-a-half minutes before launch, the vent hood is raised, and the entire arm is retracted; the process takes roughly one minute to complete. This arm is not latched into place until SRB ignition (at lift-off) in the event of a hold on the launch, which allows the arm to be re-extended.[59]

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[54] The Vacuum vent is also purged every twenty-four hours in the event of launch scrubs when the fuel cells are kept on-line. NASA. "Mission Information-Countdown 101." No date.

[55] Jessica Rye. "Status Report S05-027: NASA's Space Shuttle Processing Status Report." July 7, 2005.

[56] NASA KSC. "Pads A and B."

[57] This emergency egress system can also be used by pad personnel should there be a major accident while the Space Shuttle is being processed.

[58] Jenkins, 422; NASA KSC. "Pads A and B."

[59] NASA KSC. "Pads A and B."

The fueling process for the ET begins roughly ten hours prior to launch and takes about three hours to complete.[60] The two propellants, LOX and LH_2, are loaded onto the tank, through the two Tail Service Masts on the MLP (one per liquid). The propellant used in the tank is kept in large, spherical storage dewars at the northwest (LOX) and northeast (LH_2) of the complex.[61] The LOX tank holds roughly 900,000 gallons; the LH_2 tank stores about 850,000 gallons. Each of the tanks is filled a few weeks prior to the Space Shuttle's arrival by tanker trucks that connect to one of five loading ports at each tank.[62] When it is time to load the ET, two pumps send 1,200 gallons of LOX per minute through large pipes to the launch pad; due to its light weight, the LH_2 is sent to the pad using pressure created by vaporizing a small amount of the liquid.[63] Each of the storage tanks has an associated building with the electrical equipment that powers all of the pumps, valves, and other components necessary for operations; their dedicated staff of engineers is each housed in a nearby operations building.[64]

Unlike the orbiter and the ET, there is little processing work to be done on the SRBs at the launch pad. The only booster-specific process is the use of moveable carts to fill the SRBs' hydraulic power units with monomethyl hydrazine.[65] Additional work on the boosters falls under the procedures for overall Space Shuttle systems processing, which includes various electrical tests and checkouts to ensure that the electrical systems and connections between the shuttle components are operational. One such test is the Range Safety System functional test to ensure that the shuttle's range safety system, meant to destroy the SRBs and ET in the event of a trajectory violation, is operational.[66] Also performed is a checkout of the shuttle's ordinance (pyrotechnic) system. This includes completing the wiring of all ordinance circuitry, resistance and load testing (to insure the ordinance is properly wired), and the final "Pyro Initiator Controller" test.[67]

At sixteen seconds prior to SRB ignition, the water-based Sound Suppression System initializes from the water tower to the northeast of the launch pad. The water runs through large pipes from the tower, through the hardstand, and up to the MLP, which it reaches just prior to lift-off

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[60] Jessica Rye and Bruce Buckingham. "Status Report S05-032: NASA's Space Shuttle Processing Status Report." July 12, 2005.
[61] "NASA Centers and Responsibilities;" NASA, *Countdown! NASA Space Shuttles and Facilities*. Information Summary IS-2005-06-017-KSC (KSC), June 2005.
[62] Matt Pringle. Personal communication with Patricia Slovinac of ACI, September 30, 2009, Kennedy Space Center
[63] NASA. "Countdown!"
[64] Pringle.
[65] Like those for the orbiter's APU, these carts are stored and filled at the Hypergolic Fuel Facility. Murphy.
[66] NASA. *Reference Manual*.
[67] The "Pyro Initiator Controller" is what starts the string of small explosions to release the SRB's from the MLP, allowing the shuttle to lift off. Gerald Stewart. Personal Communication with Joan Deming and Patricia Slovinac of ACI. November 3, 2006, Johnson Space Center.

flowing at a rate of 900,000 gallons per minute. This water blankets the surfaces of the MLP to absorb the acoustical pressures and prevent damage to the orbiter and its payloads.[68]

Payload Processing

Typically, small payloads are installed in the orbiter's payload bay while it is in the Orbiter Processing Facility; larger payloads, however, are installed at the launch pad through the PCR. These payloads are brought to the launch pad inside one of two payload canisters usually before the arrival of the Space Shuttle vehicle, but can also come after the vehicle is at the pad. When the canister is in place on the hardstand, it is lifted by a large, 90-ton hoist located in the Hoist Equipment Room (HER) at the top of the RSS.[69] When the canister is aligned properly with the PCR doors, it is "…locked into position. The environmental seals of the RSS [PCR] are then inflated to seal against the sides of the canister. The space between the closed doors of the RSS and the canister are purged with clean air…The payload is then transferred into the RSS [PCR] by the Payload Ground Handling Mechanism (PGHM)."[70]

The PGHM moves from the rear of the PCR towards the doors, through the use of tracks on the floor and ceiling, to grab on to the various payloads. Support beams on each side of the PGHM contain a sequence of bolt holes, allowing J-hooks, used to latch on to the payloads, to be located as needed. Small access platforms can also be placed along the support beams to allow direct personnel access to the J-hooks/payloads. When the payloads are securely attached to the J-hooks, the PGHM is retracted. If the payloads arrive before the shuttle, they are stored inside the PCR until the vehicle arrives.[71]

After the Space Shuttle vehicle is in place, the RSS is rotated into the "mated" position, where it encloses the orbiter's Payload Bay. Once all environmental seals are in place, the PCR doors are opened, followed by the orbiter's payload bay doors, and the cargo is transferred from the PCR to the orbiter with the help of the PGHM. Once the payloads have been installed, all payload connections are made and a payload/orbiter interface test is conducted.[72] This is followed by a payload contamination walkdown, and then the payload bay doors are closed for flight.[73] During

[68] Slovinac, *Mobile Launcher Platform*.
[69] This operation has to be performed while the RSS is in its retracted position. Therefore, if the payload arrives at the pad after the Space Shuttle, the RSS must be removed from the mated position back to the retracted position. The RSS is moved through the use of two rotary bridge truck-drive assemblies that move along a curved track positioned within the pad surface. See page 26.
[70] Wallace H. Boggs and Samuel T. Beddingfield. "Moonport to Spaceport: The Changing Face at KSC." *Astronautics & Aeronautics*. July/August 1982, 35.
[71] NASA. *Equipment Handbook*, 13-1.
[72] Katherine Trinidad and Jessica Rye. "Status Report S05-024: NASA's Space Shuttle Processing Status Report." June 17, 2005.
[73] Matthews and Rye. "Status Report S05-025."

all of these procedures, the PCR is maintained as a Clean Room environment, with the help of the ECS Room.

Physical Description

The Launch Complex 39: Pad A Historic District (LC39A) is octagonal in configuration and covers roughly 160 acres of land. It is oriented along a north-south axis, and is arranged so that the launch pad is in the center, surrounded by all of the supporting facilities. The boundary of the district is the 50'-high chain link fence around the perimeter of the complex. From the south, the Crawlerway enters the complex through a large, chain link gate. Roughly 80' inwards from, and parallel to, the security fence is Perimeter Road, which completely encircles the complex. Two roads lead from Perimeter Road to the top of the pad's hardstand, one of which runs parallel to the Crawlerway, the other extends from the northwest. Additionally, three roads lead to the areas next to the hardstand, one to its west, one to its north, and one to its east. Smaller drives lead to other support facilities as well as the tops of the camera pads. Aside from the launch pad and the raised camera pads, the complex is generally flat and sits roughly 6' above mean sea level.

The focal point of LC39A is the launch pad, which is comprised of four main features: the hardstand, the FSS, the RSS, which includes the PCR, and the Flame Trench/Deflector system.[74]

The Hardstand

The launch pad hardstand (Photo Nos. 26-29) provides a structural base for the Space Shuttle vehicle when it is at the pad awaiting launch; it also supports the FSS and the RSS, and contains several internal rooms for various launch processing and pad support equipment. At ground level, the hardstand has approximate overall dimensions of 660' in length (north-south) and 546' in width (east-west).[75] From the outer perimeter concrete retaining walls slope upwards, at an eighteen degree angle on average, to the top level, or "pad surface." The pad surface, positioned 48' above mean sea level, has rough overall dimensions of 400' in length (north-south) and 348' in width (east-west).

Below the pad surface, the hardstand is essentially divided into east and west areas by the Flame Trench. Within the east section is the High Pressure Gas battery area, which has approximate overall dimensions of 110' in length (north-south), 56' in width (east-west), and 32' in height (Photo Nos. 161-163). It is composed entirely of reinforced concrete, except for the open east side. Internally, the battery is divided into six cells, each of which is separated by a full-height concrete wall and has a width of approximately 18'. Each compartment contains various storage vessels, as follows (from north to south). The first cell contains a line of vertical tanks for compressed air along the south wall, with cable trays and smaller service pipes mounted to the north wall. The second cell has a line of vertical tanks along its north wall, and just to the outside, there is a wheeled cart with a group of horizontal tanks; all of the tanks contain

[74] Launch Pad 39A is also considered to be individually eligible for listing in the NRHP.
[75] This does not include the Crawlerway to the south or the pad surface access road at the northwest.

compressed air. The third cell holds a row of vertical GOX tanks along the south wall, and a small rack of horizontal containers in the north half. The fourth and fifth cells each have vertical tanks along the north and south walls. In the fourth cell (Photo No. 162), the tanks hold GOX, and those along the north wall are thinner and stand three tanks deep; the tanks in the fifth cell contain GHe. The last cell (Photo No. 163) is a mirror image of the first cell, with a line of vertical GHe tanks on the north wall, and cable trays and smaller service pipes along the south wall.

Behind the High Pressure Gas battery area, adjacent to the Flame Trench, are the east catacombs, which are formed with reinforced concrete and create a space through which various pad utility pipes can be extended. The catacombs have rough overall dimensions of 350' in length, 34' in width, and 38' in height, and are arranged so that there are various niches along both the east and west walls with a walkway in between. The niches along the east wall have a depth of 9'; those on the west wall have a depth of 15'. Each niche is separated by a full-height reinforced concrete wall, and the sixth niche from the north, on the west side, has an access door to the underside of the Flame Deflector. To the west of the Flame Trench are the west catacombs (Photo No. 165), which are an exact mirror image of the east catacombs and have the same function. Both sets of catacombs are accessed by the piping tunnel to their south, which extends through the width of the hardstand and is accessed by openings at the east and west ends. This tunnel (Photo No. 164) has an approximate length of 466', a width of 18', and a height of 14'. Like all other areas of the hardstand, it is composed of reinforced concrete; various facility pipes and cable trays are mounted to its north and south walls, and suspended from the ceiling.

The west area of the hardstand contains the two-level ECS and Pad Terminal Connection Room building. The ECS area sits at the north end of the first level, and has approximate dimensions of 112' in length (east-west), 96' in width (north-south), and 19' in height. The main access point to this area is an exterior, metal swing door on the west wall; a metal rolling door for equipment is located to its north. Internally, the ECS is divisible into four main areas: the north area, the south area, the west area, and the east area. The west area contains five large air blowers (Photo Nos. 166-167); the north area (Photo No. 168) contains a chilled water system for cooling the air. The east area contains work spaces, as well as two tunnels (Photo No. 170) for the environmental control system ducts to pass through, and up to the launch pad surface and FSS. The south area of the ECS holds the electrical panels for all of the equipment. A small area in the southwest corner of the ECS contains the GN_2 system, with the main system at ground level and a redundant system above on a small mezzanine. A door at the southeast corner of the ECS leads to the facility's control room.

On the south wall of the ECS is a metal swing door that leads into the first level of the Pad Terminal Connection Room area, which has approximate overall dimensions of 143' in length (north-south) and 65' in width (east-west), and has a ceiling height of 16'. This floor level is divided into several rooms, the largest of which (at 95' x 24') sits along the east wall and serves as the launch pad battery facility. Two fenced in areas are located in this room, one along the east wall (Photo Nos. 171-172) and one along the south wall (Photo No. 173), which contain rows of stacked batteries. The other smaller rooms, positioned along the north, west, and south walls, contain storage facilities and mechanical equipment. Near the south end of the west wall, there is a stairwell and elevator, which rise through the second level and continue to the pad surface. To their south, opening off of the first level, is a 20'-wide tunnel that slopes downward to the west, where a pair of metal swing doors opens to the exterior. The second floor of the Pad Terminal Connection Room area is the same width as the first floor, but extends over the east half of the ECS for a total north-south length of 239'; its ceiling height is 13'-6". This floor consists of a lengthwise hallway (Photo No. 174), just west of center, with various support rooms on either side. On the west side of the hallway are ten smaller rooms that contain various work rooms, mechanical, or electrical equipment. Each room is accessed through a metal swing door. The east side of the corridor is divided into six rooms, all of which have a tile floor that is raised roughly 1'-6" above the concrete floor slab to provide space for the various communications and data cables (Photo Nos. 175-176). The four smaller rooms are accessed by a metal hinged door; the larger room at the north end by one set of double metal hinged doors; and the larger room in the southern half by both a single metal swing door and a set of double metal hinged doors.

Also within the west portion of the hardstand, to the north of the ECS area, is the Apollo-era emergency egress facility, which is comprised of four components: the egress shaft, the egress shaft termination room, the blast room, and the air supply duct. The egress shaft (Photo No. 177) originally had an opening near the north end of the pad surface, which was sealed during the Space Shuttle Program renovations.[76] From the pad surface, the roughly 3'-diameter shaft extends to the northwest for nearly 40' horizontally, where it begins to curve over an arc of 20' in length, and then continues to the west for an additional 60' until it opens into the egress shaft termination room. Over its course, the shaft covers roughly 39' vertically; at the bottom, it opens into a 3'-6" wide landing platform, which extends through the length of the egress shaft termination room. The egress shaft termination room (Photo No. 178) has approximate overall dimensions of 78' in length (east-west), 12' in width (north-south), and 8' in height. The floor of the room, as well as the shaft's landing platform, gradually slopes upwards to the west at a 4-degree angle beginning 24' from the shaft opening. The landing platform, as well as the main floor of the room, is covered by 4"-thick foam rubber; the north wall by 6"-thick foam rubber, and the west wall by 24"-thick foam rubber, which give the room its nickname of the "rubber room".[77]

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[76] The shaft connected to a tube embedded within the Apollo Program's launch umbilical tower.

[77] The rubber was installed as a means of slowing down any astronaut or pad worker who came down the shaft. The thickness of the rubber varies based on its function. The 4"-thick rubber on the landing slows down the astronaut or pad worker; the 6"-thick rubber on the north wall helps protect the person should they skim the wall on their way down; and since the west wall is the termination point of the slide, the rubber is 24"-thick to provide extra cushioning.

Within the south wall of the egress shaft termination room is a 12”-thick airlock door (Photo No. 179) that leads to the blast room. The blast room (Photo Nos. 180-182) is a hemispherical space with a radius of 15’, a 2’-6” to 4’-thick reinforced concrete slab and dome, and a 3’ diameter opening in both the dome and the floor. The finished floor sits on twenty-four, 12”-diameter isolation springs, at a height of 4’ above the concrete slab. Around the perimeter of the room are twenty contour seats with safety harnesses; in the center is a 7’-6”-diameter caged storage area. In the center of the south part of the wall is a second 12”-thick airlock that opens into a 25’-long, 6’-wide hallway that opens into the ECS through a metal swing door. At the halfway point of the length is the air supply duct (Photo No. 183), a 75” x 47” elliptical tunnel that extends westward to Perimeter Road.

At the pad surface, on either side of the Flame Trench, are the Crawlerway tracks (one to each side), each of which has a width of 27’ and extend to roughly 50’ south of the north edge of the pad surface. Around the north end of the Flame Trench are ten mount mechanisms for the MLP; five on either side (Photo No. 32).

To the west of the Flame Trench are the two most prominent features of the launch pad: the FSS and the RSS. The center point of the FSS is located 192’ south of the north edge of the pad surface, and 100’ east of the west edge; the RSS is located directly south of the FSS when in its retracted position, and southeast of the FSS when in its mated position. The RSS moves between these two locations via a rail track that curves across the pad surface, extending over the Flame Trench where it is supported by a pier. To the north of the FSS, on the west side of the Flame Trench, are the “90/99 Tower,” the Environmental Control and Life Support Systems Building, and the piping bridge that extends across the trench. At the west end of this bridge is the LOX Interface Tower; at the east end is the LH_2 Interface Tower.

The Fixed Service Structure

The FSS (Photo Nos. 34-38) has approximate overall dimensions of 75’ in length (north-south), 40’ in width, and 350’ in height, which includes the tower, the trussing that connects the tower to the RSS hinge column, and the lightning mast. It is composed entirely of structural steel with open-grate metal decking, and is supported by a central core of two elevator shafts and one “U”-shaped staircase. One of the elevators sits to the southwest of the tower’s center point, and the other sits to the southeast of the center point; the staircase sits to the northeast of the center point. The FSS consists of twelve platform levels, excluding the pad surface. Each level is supported by the four steel corner posts, and a pair of diagonal braces on each side that form an upside-down “V.” The different levels are named according to their altitude above mean sea level, as such:

Level above the pad surface	Designation
First	75' Level
Second	95' Level
Third	115' Level
Fourth	135' Level
Fifth	155' Level
Sixth	175' Level
Seventh	195' Level
Eighth	215' Level
Ninth	235' Level
Tenth	255' Level
Eleventh	275' Level
Twelfth (top)	295' Level

Additionally, the structure's four elevations are designated "Side 1" (east), "Side 2" (south), "Side 3" (west), and "Side 4" (north).

All of the FSS tower levels have the same basic layout (Photo Nos. 254-260): square in plan, with the elevators and stairs in the center, metal grate floors around this core, and handrails around the perimeter. Between the 95' and 195' Levels is the truss that connects the tower to the RSS hinge column. This truss is triangular in plan, with an overall north-south dimension of 25' and an overall east-west dimension of 40'. Throughout all of the levels are typical pieces of equipment, such as electrical outlets, communications distribution panels, electrical distribution panels, instrumentation distribution panels, power distribution panels, and Firex fire-suppression equipment. Additionally, all but one of the levels contain specific equipment and/or access platforms, necessary for the pre-launch processing of the Space Shuttle vehicle.

The 75' Level contains various equipment that supports the orbiter's electrical power fuel cells. Directly across from the east elevator door is the 'GH_2 T-0 Servicing and Control Console' (Photo No. 39); at the northwest corner of the level is the 'GOX T-0 Servicing and Control Console' (Photo No. 41). Along the north side of the 75' Level are the Hypergol Fuel Vapor Scrubber Unit (east) and the Hypergol Oxidizer Vapor Scrubber Unit (center). Each of these units (Photo No. 40) contains a liquid separator tank to their east. On the east side of the level are platforms that provide access to the GH_2 and GOX interface plates and the MLP power interface. The 95' Level does not contain any specialized equipment panels for processing the Space Shuttle. However, on the east side, there is a flip-up platform that provides access to the MLP, and on the south side, within the trussing for the hinge column, is the first catwalk access path to the RSS, which can be used when the RSS is in its retracted or mated position. This is the first FSS level that provides access to the RSS.

Both the 115’ Level and the 135’ Level of the FSS are also void of specialized equipment panels for vehicle processing. However, on the east side of the 115’ Level is the winch-controlled Orbiter Work Platform, which is composed of metal plates (Photo Nos. 44-45). A catwalk on the south provides access to the RSS hinge column, and projecting east from the hinge truss is a camera platform. At the 135’ Level, there are two catwalk ramps on the south side, one which leads to the RSS hinge and the other to the 130’ Level of the RSS. The 155’ Level (Photo No. 46) of the FSS holds the winch for the Orbiter Work Platform (Photo No. 50) on its east side. Directly to the west of the elevators at this level is the GH_2 Fuel Cell Servicing System Servicing Console (Photo No. 47); the GOX Fuel Cell Servicing System Servicing Console sits on the north side (Photo No. 48). Also along the north side of the 155’ Level, beneath the stairs, is the GN_2/GH_2 Service Panel (Photo No. 49), which supports the orbiter’s Environmental Control and Life Support System. A catwalk on the south side provides access to the 158’ Level of the RSS where the OMBUU platforms are located.

The 175’ Level of the FSS contains the ‘Shuttle Service and Access Tower/PCR Primary GHe Regulator Panel’ (Photo No. 53) at the northeast corner and the ‘Shuttle Service Access Tower/PCR Primary GN_2 Regulator Panel’ (Photo No. 52) at the southwest corner.[78] These provide the central control for all gaseous helium and nitrogen used throughout the FSS and the RSS. At the southeast corner of the level is the GN_2 Hazardous Equipment and Camera Purge Panel (Photo No. 51), which provides a high volume purge of GN_2 and water to protect eleven FSS film cameras during the launch process. From the main stairs within the north half of the tower, a small set of steps leads up to the 203’ Level, which contains ECS ducts. A catwalk on the south side of the 195’ Level provides access to the RSS hinge column. On the west side of the level are seven emergency egress baskets (Photo Nos. 56-57) for crew members or pad personnel in the event of an emergency situation at the launch pad.[79] Hinged to the south end of the east side of the 195’ Level is the OAA (Photo Nos. 72, 73, 79), next to which is an oxygen analyzer panel. The OAA measures approximately 65’ in length, 5’ in width, and 8’ in height, and provides access to the orbiter’s crew module through the “White Room” (Photo Nos. 74-78).

Along the north side of the 195’ Level is the base support truss for the ET/IT Access Arm. Triangular in plan, this 20’-high, two-level truss begins at the northwest corner of the FSS and extends to the northeast corner, where it reaches a width of roughly 10’. From the northeast corner, the truss becomes a roughly 40’-high, four-level rectangular structure that extends out to the east for approximately 32’. Supported by this structure (Photo Nos. 80, 83) are the various umbilical pipes required for processing the ET’s intertank. Access to the intertank is via the ET/IT Access Arm, which is attached to the northeast corner of the support structure through a

[78] The Shuttle Service and Access Tower was the original name for the FSS. An exact date for the switchover is unknown, but by the time the drawings for LC39 Pad B were completed, FSS was the official nomenclature. Reynolds, Smith and Hills, Jacksonville. “Modifications to Launch Pad 39B for Space Shuttle-Task II.” December 1978. Engineering Documentation Center, Kennedy Space Center.

[79] The baskets end at the Slidewire Termination Facility, see pages 30-31.

hinge connection (Photo Nos. 81, 82). This arm measures about 48' ft in length and has an approximate width of 5'.

The 215' Level of the FSS contains a variety of panels that support the servicing of the ET. All of these panels sit within the north half of the platform and include, from east to west, the 'ET Vent Valve Actuation and Purge Panel' (Photo No. 60); the 'GN_2 Intertank Purge Panel' (Photo No. 61); the 'LH_2 Vent Line Press. and Purge Panel' (Photo No. 62); and the 'GN_2 ET Anti-Ice Panel.' At the southeast corner of the 215' Level is the Cabin Air Panel Assembly for the orbiter. From the north side of the platform, the ET/IT Access Arm can be accessed; from the south, there is a catwalk to the 206' Level of the RSS. The 235' Level of the FSS (Photo Nos. 64-65) contains no specific equipment panels or any means of access to the RSS. At the 255' Level (Photo No. 66), there are two hydraulic fluid tanks and their associated control console in the center of the north side (Photo No. 67). The last elevator landing is also at this level, but the stairs continue to the top of the FSS.

The 275' Level of the FSS contains the 'GN_2 Line Press Regulator System' (Photo Nos. 68-69), complete with tanks and control panels, in the north half of the platform. Hinged to the north end of the east side of this level is the 'ET GOX Vent Arm' and "beanie cap," used to heat the LOX vent system at the top of the ET to prevent ice formation. The vent arm (Photo No. 84) has rough dimensions of 80' in length, 5' in width, and 8' in height; the "beanie cap" (Photo No. 85) is conical in shape and has a diameter of 13' and a height of roughly 8'. A set of steps in the northwest corner provides access to the top level of the FSS, while another set of steps to its southeast leads to the 280'-6" Level, which contains the Elevator Machinery Room, located above the south half of the 275' Level. The only equipment at the 295' Level of the FSS is its lightning mast. Comprised of fiberglass reinforced plastic, the lightning mast (Photo No. 71) measures 80' in height and has a 5' diameter. A grounding cable, which begins at an anchor in the ground roughly 1000' south of the FSS, wraps around the entire height of the mast before extending to another anchor in the ground roughly 1000' to the north of the FSS.

The Rotating Service Structure

The RSS (Photo Nos. 91-92) has overall dimensions of approximately 163' in length (north-south), 59' in width and 189' in height.[80] It is composed entirely of structural steel with open-grate metal decking, and is typically accessed from the FSS. At its north end, the RSS is bolstered by the hinge column (Photo No. 93-94), which has a 3'-6" diameter and a height of 160'. On its south end, the RSS is supported by two rotary bridge truck-drive assemblies (south). Each truck (Photo No. 95) has rough overall dimensions of 23' in length, 8' in width, and 9' in height, and is equipped with eight wheels, allowing the RSS to be rotated along its rail (Photo

[80] All directional references assume the RSS is in its retracted position.

No. 96) between its retracted and mated positions. The trucks each have four tie-down wedges at both positions to secure the RSS in place.

The RSS itself contains five levels (107' Level, 120' Level, 130' Level, 158' Level, and 207' Level), excluding the roofs of the RCS Room and the HER, which sit on the top level of the RSS. The RSS is typically reached from the FSS; access among the RSS levels is generally through internal metal staircases. The 107' Level of the RSS, which can be accessed by a catwalk from the 95' Level of the FSS, has approximate overall dimensions of 70' in length (north-south) and 41' in width (east-west), and is essentially divided in half by a cut-out for the orbiter's vertical stabilizer. Within the north part of the platform is the hypergolic fuel equipment (Photo No. 149) for the orbiter's aft RCS; in the south part is the hypergolic oxidizer equipment (Photo No. 148) for the aft RCS. In both cases, this equipment consists of a skid, a valve complex, a GHe purge system, and a GN_2 purge system; the electrical equipment for each is located on a mezzanine level, roughly 117' above mean sea level. This level also contains access platforms for the aft RCS, two fan rooms, one at the northwest corner and the other at the southwest corner, as well as two access platforms to the PCR, one at each end. In addition, there are numerous flip-up access platforms.

The 120' Level of the RSS has the same rough dimensions as the 107' Level, but can only be accessed from the stairs within the structure. This level contains mostly generalized service equipment and control panels, such as chilled water stations, ammonia stations, air stations, and electrical panels. More specialized equipment at this level includes the access platforms for the orbiter's APU, a control station for the payload canister hoist near the northeast corner, a control station for the 90-ton hoist (housed in the HER), and one small winch on either side of the vertical stabilizer opening. Additionally, the fan rooms from the 107' Level continue through the 120' Level.

The 130' Level of the RSS is mostly comprised of the PCR and its associated anteroom, airlock, elevator, and storage area, to be described below. At the 158' Level of the RSS, which can be reached from the 155' Level of the FSS, access is provided for the OMBUU (Photo Nos. 143-145), which sits near the northeast corner of the platform. The OMBUU has approximate overall dimensions of 20' in length (north-south), 12' in width, and 18' in height, and is comprised of three levels. The roof level does not contain any specialized equipment. The first and second levels (158' and 167' above mean sea level, respectively) contain the umbilical flexline support, which is essentially a sideways, "U"-shaped frame that holds all of the umbilical hoses necessary for servicing the orbiter's midfuselage. The various control panels for the OMBUU are found throughout the first two levels.

The 207' Level of the RSS, also known as its Roof Level, is typically accessed through a catwalk from the 215' Level of the FSS. At this level are the RCS Room on the east side and the HER on the west side. Located around these two areas are various electrical panels, communications panels, and other control panels; mounted along the west edge are numerous satellite dishes. The HER (Photo Nos. 135-136) has rough overall dimensions of 36' in length (north-south), 28' in width, and 14' in height, and has a "T"-shaped plan. In the east side of the HER is the 6-ton hoist for the Line Replaceable Units; its control panel is to the immediate west and its drum unit further to the west. Throughout the remainder of the room are the various power panels, compressors, and other control panels to operate the small access platforms throughout the RCS Room.

The RCS Room (Photo Nos. 137-139) has approximate dimensions of 32' in length (north-south), 28' in width, and 31' in height, and is comprised of a main level and a mezzanine level (215' above mean sea level). Nearly the entire nose of the orbiter fits within the RCS Room, which has a metal rolling door on the east wall to allow proper placement of the orbiter within the area. Along the west wall of the room are the GHe (south) and GN_2 (north) panels for the orbiter's forward RCS. Hypergolic fuel panels for the forward RCS are situated along the north wall, while the associated oxidizer panels are along the south wall. Near the northwest corner of the orbiter opening is the control panel for the GN_2 purge system for the orbiter's windows. The mezzanine level of the RCS room contains additional equipment panels, as well as various access platforms for the forward RCS motors.

The aforementioned PCR (Photo Nos. 100-101) is the principle feature of the RSS. Located in the center of the structure, the PCR has approximate overall dimensions of 48' in length (north-south), 40' in width (east-west), and 74' in height, excluding the anteroom, airlock, elevator, and storage areas. Internally, the PCR contains six platform levels, which includes Level "0" (130' above mean sea level; Photo Nos. 102-103), Level "1" (140' above mean sea level; Photo Nos. 104-106), Level "2" (150' above mean sea level; Photo Nos. 107-108), Level "3" (158' above mean sea level; Photo Nos. 109-110), Level "4" (170' above mean sea level; Photo Nos. 111-112), and Level "5" (182' above mean sea level; Photo Nos. 113-114). At each level, there is a 16' x 15' open work platform on the north and south sides, with eight, 1'-wide extensible planks mounted on the east end of the underside. These platforms contain generalized equipment, such as hose reels, vacuum pumps, and power receptacles. Suspended from the PCR ceiling are two 2-ton hoist cranes (Photo No. 115), one at the northwest corner and the other at the southwest corner; their control stations (Photo No. 116) are located on Level 4.

Between the north and south platforms of the PCR is the PGHM (Photo Nos. 118, 123, 135), which has approximate overall dimensions of 23' in length (north-south), 13' in width (east-west), and 69' in height. The PGHM contains five platform levels and a "roof", all of which are accessed by metal steps along the west side that begin at the PCR floor. The structure is capable of moving along an east-west axis via rails on the PCR floor (Photo No. 119) and tracks at the top of the north and south walls (Photo No. 120). Each PGHM level has three-sectioned moveable platforms (Photo No. 119) that extend out to the east, as well as two PGHM Hook Instrumentation Unit Panels (Photo No. 124), any of which can be utilized. At the northeast and southeast corners of the structure, there are 55'-high I-beams that contain holes spaced every 4" on center that allow small access platforms and "J"-hooks (which hold the payload) to be positioned where needed (Photo Nos. 126, 127).

The east wall of the PCR contains the main PCR doors (Photo Nos. 129, 131), each of which is 62' in height and corresponds to one of the orbiter's payload bay doors. Each PCR door is comprised of two sections that are hinged to one another. The inner section of each door (which is hinged to the PCR wall) is 6'-6" in width; the outer section is 14' in width, and contains a 7' x 3' personnel door. When closed, the doors are secured by a torque tube fitted with five latches. Rollers in the bottom of the doors and tracks in the PCR roof (Photo No. 132) provide the means of opening and closing the doors.

As previously mentioned, the PCR has four general support areas. The PCR's anteroom (Photo No. 98) sits to its west and serves as the primary entrance to the PCR for pad personnel. It has rough overall dimensions of 55' in length (north-south), 17' in width (east-west), and 13' in height, and is entered through a metal swing door in the south wall. The anteroom contains personnel lockers and restrooms along the west wall, and storage bins on the south wall for the special work suits that the personnel must wear once the PCR has been designated a true "clean room" in preparation for the arrival of a payload. All personnel must access the PCR through an air shower that sits on the east wall (Photo No. 99). Along the north wall of the PCR is its associated airlock, which has approximate dimensions of 14' in length (east-west), 11' in width (north-south), and 15' in height. This room contains no equipment, but features a set of double metal hinged doors on the west wall (into the anteroom), a set on the south wall (from the PCR), and a set on the north wall (out to the RSS).

The PCR's elevator area sits to its south, and roughly measures 28' in length (north-south) and 26' in width (east-west) at Level 0, and 26' in length (east-west) and 14' in width (north-south) on all other levels; the entirety has a height of 78', which includes the equipment room at the top. This elevator provides access to all levels of the PCR. At each level, the elevator doors open onto a landing to its east, where there is a pair of metal swing doors on the north wall that open into the PCR. Finally, the PCR has a storage area (Photo No. 133) situated to its south on the 130' Level of the RSS. This room measures approximately 32' in length (east-west), 28' in width (north-south), and 15' in height, and is accessible only from the PCR through the elevator area. Internally, it is comprised of a caged area along the west wall, metal shelves along the outside of the cage, and an open storage area in the eastern section of the room.

The Flame Trench and Deflectors

The Flame Trench (Photo Nos. 152, 153, 155), which measures approximately 490' in length, 58' in width, and 42' in height, is constructed of concrete and faced with refractory brick. The trench begins approximately 150' north of the south edge of the pad surface; the bottom slopes downward at a twenty-two degree angle for about 24’, and stays flat for the remainder of its length. At the north end of the pad surface, the walls of the trench angle out towards the west and east, in conjunction with the retaining wall system of the hardstand (Photo No. 152). The Deflector system consists of two main elements. The first is an inverted V-shaped steel structure (Photo Nos. 154, 156-158) that sits within the trench and has rough overall dimensions of 114’ in length, 58’ in width, and 44’ in height; its apex sits approximately 205’ from the north end of the pad surface. This deflector is comprised of two halves that sit back-to-back, and are sealed by the leading edge (apex). The north deflector is shaped for the SRBs, and has rough dimensions of 31’ in length (north-south), 58’ in width (east-west), and 44’ in height. This deflector is moveable through the use of four wheel-truck assemblies; locked into place by anchors in the Flame Trench floor; and contains the leading edge that fits over the south deflector, which is formed around the SSMEs. The SSME deflector has approximate dimensions of 83’ in length (north-south), 58’ in width, and 42’ in height, and is not capable of being moved. The other element of the Deflector system is known as the Solid Rocket Motor Side Flame Deflectors (Photo Nos. 159, 160). This consists of a pair of moveable deflectors, with rough dimensions of 50’ in length, 58’ in width, and 20’ in height, that sit on rails on the pad surface, one on each side of the Flame Trench. Their position along the north-south axis may be adjusted to anywhere between the apex of the main deflector (launch position) and the north end of the pad surface (storage position).

Ancillary Features that contribute to the Historic District

The **Water Tank** (J8-1610; Photo No. 191) is located to the northeast of the launch pad hardstand and is part of the launch pad’s Sound Suppression System, which protects the orbiter and its payloads from damage by acoustical energy reflected off of the MLP during liftoff. The tank itself consists of three parts: the storage drum, the support stands, and the riser pipe. The storage drum has a diameter of roughly 45’, and a height of 32’, excluding the vent and beacon light at the top. It is supported by five legs, spaced equidistant from each other, around the tank’s perimeter based on a diameter of 68’. Between each pair of legs are five horizontal braces, and five pairs of cross-braces for additional support. Each leg has a vertical height of 238’ from its own, individual concrete foundation to where it meets the tank. Each is angled 6-degrees out from vertical, for a total length of 239.5’ for each leg. The riser pipe has an internal diameter of 144”; it extends from the bottom center of the tank to a concrete base/support cover, where a 90-degree miter directs the pipe westward, where it splits into six smaller pipes that connect to the main valve station (Photo No. 187). To the west of the station, these six branches merge back into two 84”-diameter pipes which continue to the west side-by-side, until they are redirected southward to the launch pad. These two pipes enter the hardstand one above the other (Photo No. 188), where they enter and travel through the east catacombs. Within the catacombs, these two pipes are again divided into smaller branch pipes, which extend up to the pad surface, into the MLP, or into the main deflector. One pipe is directed through the underside of the main deflector, where it enters the west catacombs (Photo No. 189) before it is divided into smaller pipes that extend to the pad surface or the MLP (Photo No. 190). The peak flow rate of the Sound Suppression System is 900,000 gallons per minute; this occurs approximately nine seconds after liftoff.

The **Slidewire Termination Facility** (J8-1703) is located to the west of launch pad (Photo Nos. 192-193). It consists of two main areas: the termination point for the emergency baskets that sit at the 195' Level of the FSS and the adjacent shelter building. The termination area has seven landings, one for each basket, which are comprised of wooden frames with nets (Photo No. 194). A second wooden frame and net, closer to the pad, serves to slow down the basket. Underneath the termination area is a large sand trap with concrete walkways from each net to the bunker building. The bunker, which sits to the south of the termination area, has a grass roof and rough dimensions of 29' in length and 16' in width (Photo Nos. 196-197). Internally, it has a ceiling height of 8'-5"; it's overall outer height is roughly 15'. The internal layout of the shelter consists of one open area, with benches mounted to the long walls, and various breathing air and communications stations. A louvered metal swing door provides access to the shelter, and there is a large metal rolling door for larger pieces of equipment.

To the northwest of the launch pad is the liquid oxygen complex, which consists of a storage tank, an electrical equipment building, and a small office building. The storage tank, officially known as the **LOX Facility**, (J8-1502) is a large spherical container, with a diameter of approximately 64' (Photo Nos. 198-199). It is comprised of a double-shell with a layer of perlite insulation in between; the outer shell is composed of carbon steel and the inner shell is made of stainless steel. Sixteen support posts are equally-spaced around the perimeter of the tank, which extend from the concrete foundation slab to the equator of the tank. Cross-bracing is situated between each post for added stability. A vent cap is situated at the top of the tank, and is reached via a set of metal steps that starts on the southeast side of the tank, extends straight to about the equator, and then wraps around the upper half of the tank to the top. On the northeast side of the tank, there are five fill points for LOX to be transferred from tanker trucks into the tank. To the southeast are numerous pipes linking the tank to its electrical equipment building as well as extending up to the launch pad itself (Photo No. 199). The entirety rests on a poured concrete foundation, which measures roughly 165' in length and 135' in width.

To the south of the LOX Facility is its associated equipment building, referred to as **Electrical Equipment Building No. 2** (J8-1553). This small, one-story structure (Photo No. 201) is composed entirely of poured concrete, and has approximate overall dimensions of 29' in length, 19' in width, and 12' in height. The entrance to this building is comprised of a metal, blast-resistant door on the north elevation; the remaining elevations are void of openings. Within the building are various electrical panels and consoles located around the floor area or mounted to the walls.

The LOX Facility's **Operations Support Building A-1** (J8-1503) is a one-story structure located to its northeast, with approximate overall dimensions of 30' in length, 30' in width, and 14' in height (Photo No. 202). The walls of the building are composed of poured concrete posts and beams, with concrete block infill; it has a flat, built-up roof and a poured concrete slab foundation. The south elevation, which faces the launch pad, contains one metal rolling door, and the east elevation has one pair of metal swing doors near the north end. The north elevation has one metal swing door towards its west end; and the west elevation has one metal swing door at the north end. Attached to the north elevation is a 6' x 6' x 8.5' mechanical room with a louvered swing door on its north elevation. The double doors on the east elevation serve as the main personnel entrance for the facility. Internally, the building is divisible into four areas. The first is a 10' x 10' entrance area, which is accessed via the double doors on the east elevation. Directly to its south is a 10' x 10' office, with a 9' x 10' support room to its south. The remainder of the building consists of a large open shop area with work tables, shelving, and cabinets along the walls and tables in the center (Photo Nos. 203-204).

To the northeast of the launch pad is the liquid hydrogen complex, which, like the LOX complex, consists of a storage container, an electrical equipment building, and an office building, but also includes a flare stack. The storage tank, or **LH_2 Facility** (J8-1513; Photo Nos. 205-206), is a large spherical container, with a diameter of approximately 68'. It is comprised of a double-shell with a layer of perlite insulation in between; the outer shell is composed of carbon steel and the inner shell is made of stainless steel. Twelve support posts are equally-spaced around the perimeter of the tank, which extend from the concrete foundation slab to the equator of the tank. Cross-bracing is situated between the posts for added stability. A vent cap is situated at the top of the tank, and is reached via a set of metal steps that starts on the northwest side of the tank, extends straight to about the equator, and then wraps around the upper half of the tank to the top. On the northeast side of the tank, there are five fill points for LH_2 to be transferred from tanker trucks into the tank. Also on this side is its water-filled vaporizer, which is used to build pressure within the storage tank. To the southwest are numerous pipes linking the tank to its electrical control building as well as extending up to the launch pad itself. The poured concrete foundation measures 80' in length and 80' in width.

The LH_2 complex's associated **Flare Stack** (J8-1611; Photo No. 207) is located to the southwest of the tank, roughly halfway along the supply pipes that carry the LH_2 to the launch pad. Used to vent the LH_2 tank on the ET, the flare stack consists of two vertical vent pipes, separated and stabilized by horizontal and cross-bracing, which have an approximate overall height of 105'. The vent pipe closest to the launch pad has a diameter of 23"; that to its northeast has a diameter of 17". The stack has a 9'-6"-square concrete slab foundation and is equipped with various lightning protection lines extending to the ground. At the top of each pipe, is a vent opening to release any extra hydrogen that could cause an explosion.

To the south of the LH_2 Facility is its equipment facility, known as **Electrical Equipment Building No. 1** (J8-1563). Like Electrical Equipment Building No. 2, it is a one-story structure composed entirely of poured concrete but with approximate overall dimensions of 27' in length, 17' in width, and 13' in height (Photo No. 208). Its entrance, a metal, blast-resistant door, is on the north elevation; there are no openings on any of the other elevations. Inside, the building is comprised of a single room, with electrical panels and support equipment within the floor area and mounted to the walls (Photo No. 209).

The office building for the LH_2 Facility, **Operations Support Building A-2** (J8-1614), is located to the southeast of the storage tank. It has approximate overall dimensions of 35' in length, 35' in width, and 14' in height (Photo No. 210). The walls of the building are composed of poured concrete posts and beams, with concrete block infill; it has a flat, built-up roof and a poured concrete slab foundation. The west elevation, which faces the launch pad, is void of openings, as is the east elevation. The south elevation has one metal swing door just east of the centerline, and a metal rolling door toward the west end. The north elevation has an attached, 8' x 6' x 8.5', mechanical room towards the east end, with a louvered swing door on its north elevation. The metal swing door on the south elevation serves as the main personnel entrance for the facility. Internally, the building consists mainly of a large open shop area with work tables, shelving, and cabinets along the walls. Within the southeast corner of the interior is a 10' x 9' utility area.

The **High Pressure GH_2 Facility** (J8-1462) is an open-air structure that sits to the northeast of the launch pad, and to the northwest of the LH_2 Facility (Photo Nos. 211-212). It is comprised of a large reinforced concrete slab and two walls. The slab has rough overall dimensions of 156' in length and 80' in width, and is oriented so that the long dimension extends from the southwest to the northeast. The two walls are positioned near the northeast end of the slab. The longer wall has a length of approximately 64' and sits roughly 40' from, and parallel to, the northeast end of the slab. From the southeast end of this long wall and at a 90-degree angle, extends the second wall, which has a length of roughly 40'. Both walls stand 10' in height. Next to and parallel to the short wall, are three bottle banks of GH_2. Each bank contains twelve bottles in two columns, stacked six high. The long wall provides a mount for the various control panels and conduits associated with the facility.

To the southeast and southwest of the launch pad are the hypergol oxidizer and fuel complexes, respectively, each of which consists of a storage structure and an electrical equipment building. The **Hypergol Oxidizer Facility** (J8-1862; Photo No. 219) and the **Hypergol Fuel Facility** (J8-1906; Photo No. 213) are both one-story structures with approximate overall dimensions of 68' in length, 40' in width, and 22' in height. The foundation of each facility is constructed of poured concrete; the galvanized steel gable roof is supported by steel columns and trusses, three on each side. The foundation pad on each structure extends past the roofed area for roughly 40' from one of the smaller sides. Under the roof of the structure, there are various pumps, scrubbers, and storage tanks that hold oxidizer or fuel that is then delivered to the launch pad through pipes to the northwest (oxidizer facility) or the northeast (fuel facility). Additionally, the fuel facility stores two different types of moveable carts (Photo Nos. 214, 215), which are filled at the facility and then taken to either the MLP or the RSS to fill the hydraulic power units on the SRB and the orbiter's APUs, respectively.

Each of these facilities has an associated equipment building situated to the northeast of the storage area, **Electrical Equipment Building No. 3** (J8-1811) for the oxidizer area and **Electrical Equipment Building No. 4** (J8-1856) for the fuel area. Both have approximate dimensions of 20' in length, 15' in width, and 10' in height, with walls and a roof of galvanized steel, and a poured concrete slab foundation (Photo Nos. 221; 217-218, respectively). The entrance to each facility consists of a pair of metal swing doors, situated on the south elevation. Internally, each building is a single-room space, with electrical equipment mounted to the floor and walls.

The **Water Chiller Building** (J8-1707) is a one-story structure located to the west of the launch pad hardstand. It has approximate dimensions of 26' in length, 17' in width, and 14' in height, and is constructed entirely of poured concrete (Photo No. 222). The entrance to this facility, a metal swing door, is located at the east end of the north elevation. Other exterior features include a small damper on the west elevation and aluminum intake louvers on the east elevation. The internal layout of the building (Photo No. 223) consists of one open area, with large chillers mounted to the floor and various support panels mounted to the walls.

Five camera pads are located around the perimeter of the launch complex. Each is an 18'-high earthen mound (Photo No. 224), with approximate dimensions of 151' in length and 22' in width. The mound supports a 12'-wide asphalt access road, and four, 16'x6' concrete camera pads. The differences between the camera pads lie in the quantity and type of camera pedestal on each. **Camera Pad A No. 1** (J8- 1512) is located in the northwest area of LC39A. Its four camera pads have four, three, four and four camera pedestals respectively from the southwest to the northeast (Photo No. 225). Each pedestal has a pyramidal base with a mount post in the center of the side of the base nearest the launch pad. The cameras, when mounted to a pedestal, are surrounded by blast-proof metal casings that resemble a standard mail-box.

The four other camera pads are situated around the perimeter of the launch complex as follows: **Camera Pad A No. 2** (J8-1714) to the east of the launch pad, **Camera Pad A No. 3** (J8-1961) to the southeast; **Camera Pad A No. 4** (J8-1956) to the southwest; and **Camera Pad A No. 6** (J8-1554) to the northeast. On its four camera pads, No. 2 has two, four, four, and three pedestals, respectively, from south to north (Photo No. 226). Four of the total pedestals are like those on No. 1; the others are three-legged pedestals with no lower base (i.e., the legs are mounted directly to the camera pad). In addition, between the two northern pads is a free-standing camera, composed only of a single support post (Photo No. 233). No. 3 has two, three, three, and two pedestals, respectively, from southwest to northeast on its camera pads (Photo No. 227). All of the pedestals are like those on No. 1 except for one, which is like the three-legged stand on No. 2 except that it has a circular lower base (Photo No. 231). In addition, there are four individual concrete camera pedestals at the very northeast of No. 3 (Photo No. 233). The camera pads on No. 4 have four, four, four, and two pedestals, respectively, from southeast to northwest (Photo No. 228). All but two of the total pedestals are like those on No. 1; the others are three-legged pedestals with no lower base, similar to those at No. 2. In addition, there are two individual concrete camera pedestals at each end. At No. 6, the four camera pads have two, four, four, and two pedestals, respectively, from southeast to northwest (Photo No. 229). Eight of the total pedestals are like those on No. 1; the others are three-legged pedestals with no lower base.

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**APPENDIX A: Launch Complex 39: Pad A Historic District
Maps and Lists of Contributing/Noncontributing Resources under the Space Shuttle Program and the Apollo Program Contexts**

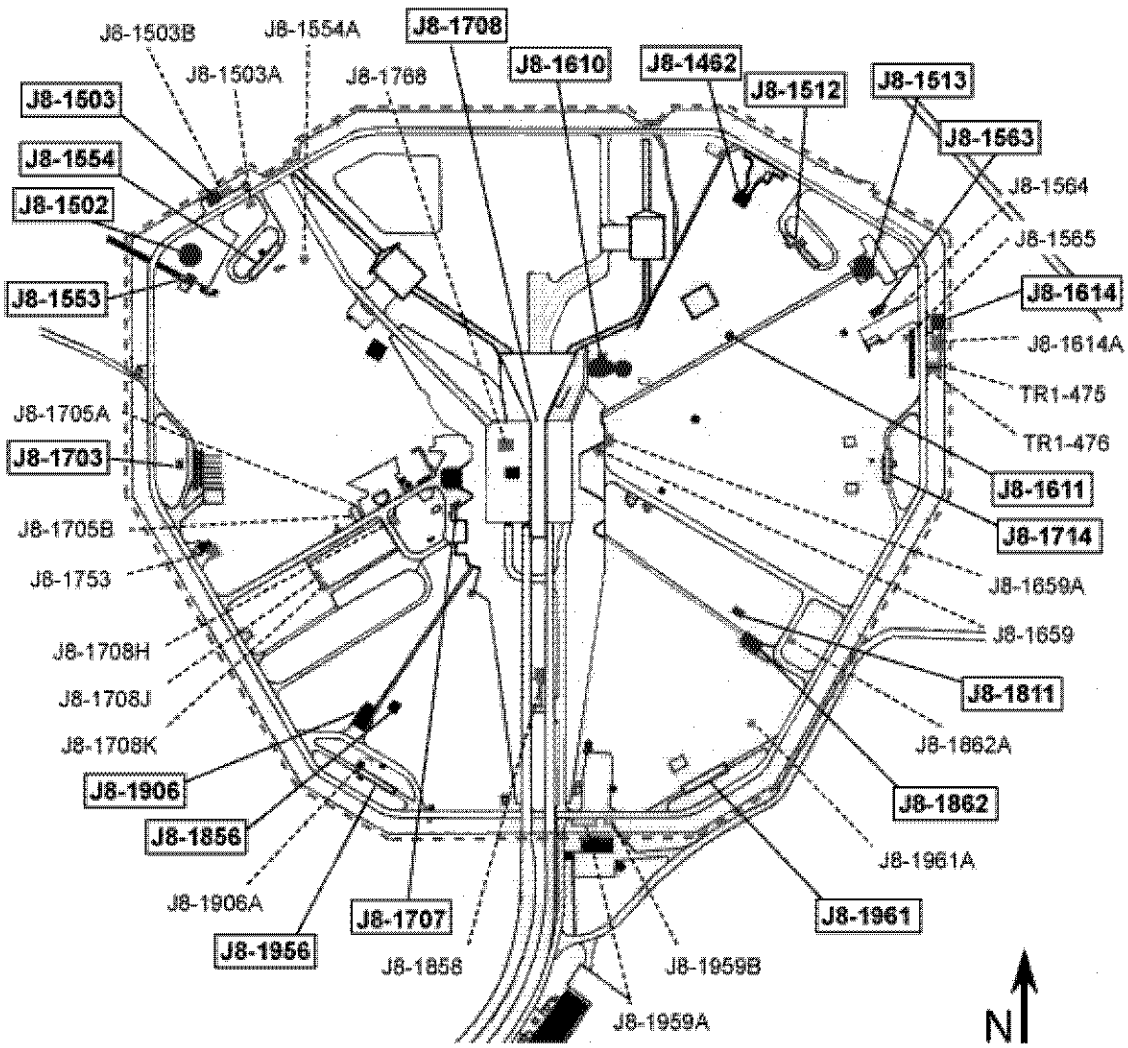

Figure A-1. Map showing contributing (bold-faced and boxed) and noncontributing resources to the LC39A Historic District under the Space Shuttle Program context.

List of Contributing/Noncontributing Resources under the Space Shuttle Program Context

J8-1462	High Pressure GH2 Facility	Contributing
J8-1502	LOX Facility	Contributing
J8-1503	Operations Support Building A-1	Contributing
J8-1503A	Storage Building	Noncontributing
J8-1503B	LOX Engineering Office Building	Noncontributing
J8-1512	Camera Pad A No. 1	Contributing
J8-1513	LH2 Facility	Contributing
J8-1553	Electrical Equipment Building No. 2	Contributing
J8-1554	Camera Pad A No. 6	Contributing
J8-1554A	Camera Pad 6 Meteorological Tower	Noncontributing
J8-1563	Electrical Equipment Building No. 1	Contributing
J8-1564	Foam Building	Noncontributing
J8-1565	Pump House	Noncontributing
J8-1610	Water Tank	Contributing
J8-1611	Flare Stack	Contributing
J8-1614	Operations Support Building A-2	Contributing
J8-1614A	LH2 Engineering Office Building	Noncontributing
J8-1659	Compressed Air Building	Noncontributing
J8-1659A	Equipment Shelter	Noncontributing
J8-1703	Slidewire Termination Facility	Contributing
J8-1705A	Sewage Lift Station	Noncontributing
J8-1705B	Sewage Equipment Building	Noncontributing
J8-1707	Water Chiller Building	Contributing
J8-1708	Launch Complex 39: Pad A	Contributing
J8-1708H	Rain Shelter	Noncontributing
J8-1708J	Hazardous Waste Storage Building	Noncontributing
J8-1708K	Hazardous Waste Storage Building	Noncontributing
J8-1714	Camera Pad A No. 2	Contributing
J8-1753	Remote Air Intake Building	Noncontributing
J8-1768	Environmental Control and Life Support	Noncontributing
J8-1811	Electrical Equipment Building No. 3	Contributing
J8-1856	Electrical Equipment Building No. 4	Contributing
J8-1862	Hypergol Oxidizer Facility	Contributing
J8-1858	Azimuth Alignment Station	Noncontributing
J8-1862A	Storage Building	Noncontributing
J8-1906	Hypergol Fuel Facility	Contributing
J8-1906A	Storage Building	Noncontributing
J8-1956	Camera Pad A No. 4	Contributing
J8-1959A	Rain Shelter	Noncontributing
J8-1959B	Rain Shelter	Noncontributing
J8-1961	Camera Pad A No. 3	Contributing
J8-1961A	Camera Pad 3 Meteorological Tower	Noncontributing
TR1-475	Touchton (Boxcar)	Noncontributing
TR1-476	Touchton (Boxcar)	Noncontributing

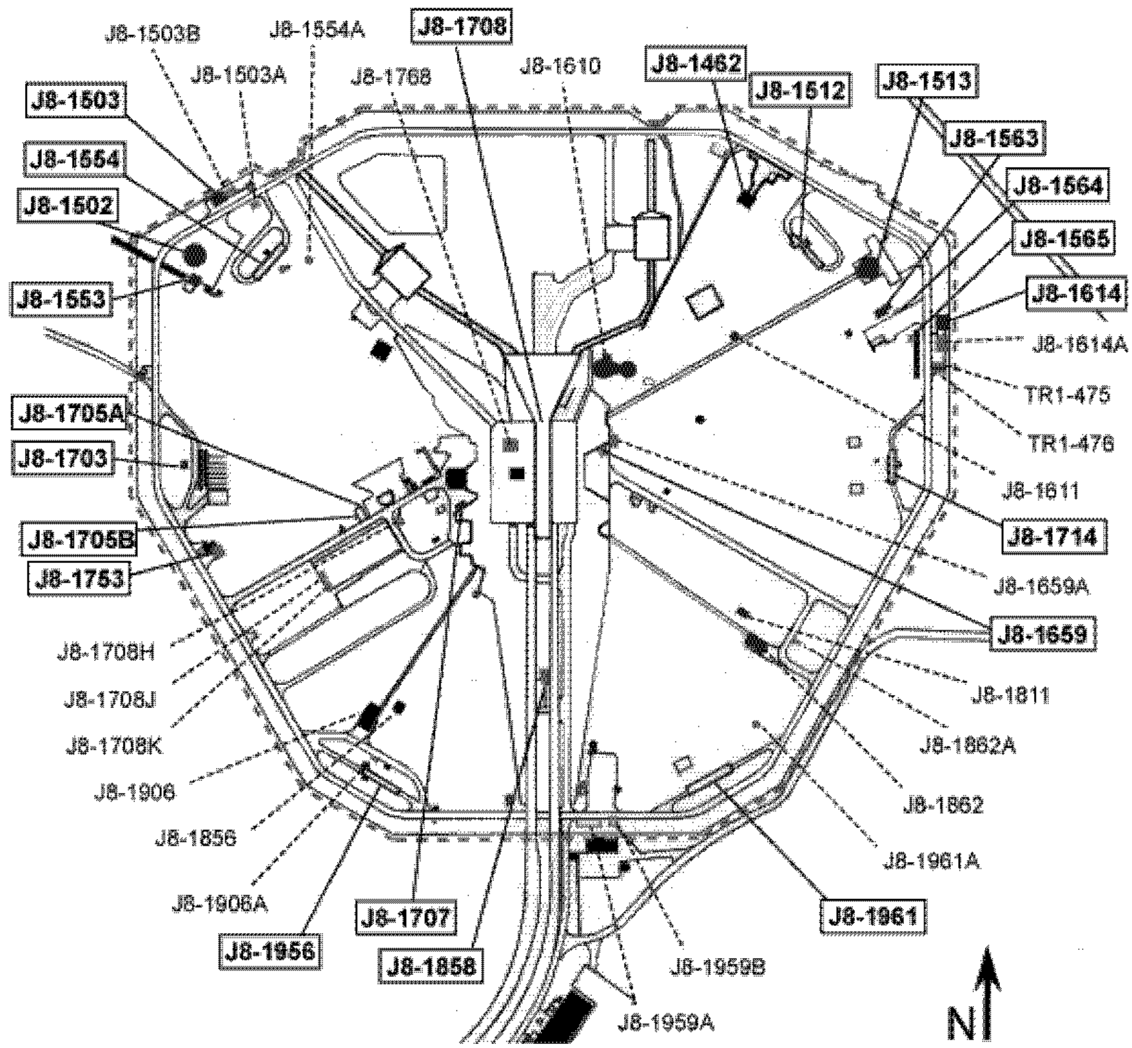

Figure A-2. Map showing contributing (bold-faced and boxed) and noncontributing resources to the LC39A Historic District under the Apollo Program context.

List of Contributing/Noncontributing Resources under the Apollo Program Context
(extant facilities only)

J8-1462	High Pressure GH2 Facility	Contributing
J8-1502	LOX Facility	Contributing
J8-1503	Operations Support Building A-1	Contributing
J8-1503A	Storage Building	Noncontributing
J8-1503B	LOX Engineering Office Building	Noncontributing
J8-1512	Camera Pad A No. 1	Contributing
J8-1513	LH2 Facility	Contributing
J8-1553	Electrical Equipment Building No. 2	Contributing
J8-1554	Camera Pad A No. 6	Contributing
J8-1554A	Camera Pad 6 Meteorological Tower	Noncontributing
J8-1563	Electrical Equipment Building No. 1	Contributing
J8-1564	Foam Building	Contributing
J8-1565	Pump House	Contributing
J8-1610	Water Tank	Noncontributing
J8-1611	Flare Stack	Noncontributing
J8-1614	Operations Support Building A-2	Contributing
J8-1614A	LH2 Engineering Office Building	Noncontributing
J8-1659	Compressed Air Building	Contributing
J8-1659A	Equipment Shelter	Noncontributing
J8-1703	Slidewire Termination Facility	Contributing
J8-1705A	Sewage Lift Station	Contributing
J8-1705B	Sewage Equipment Building	Contributing
J8-1707	Water Chiller Building	Contributing
J8-1708	Launch Complex 39: Pad A	Contributing
J8-1708H	Rain Shelter	Noncontributing
J8-1708J	Hazardous Waste Storage Building	Noncontributing
J8-1708K	Hazardous Waste Storage Building	Noncontributing
J8-1714	Camera Pad A No. 2	Contributing
J8-1753	Remote Air Intake Building	Contributing
J8-1768	Environmental Control and Life Support	Noncontributing
J8-1811	Electrical Equipment Building No. 3	Noncontributing
J8-1856	Electrical Equipment Building No. 4	Noncontributing
J8-1858	Azimuth Alignment Station	Contributing
J8-1862	Hypergol Oxidizer Facility	Noncontributing
J8-1862A	Storage Building	Noncontributing
J8-1906	Hypergol Fuel Facility	Noncontributing
J8-1906A	Storage Building	Noncontributing
J8-1956	Camera Pad A No. 4	Contributing
J8-1959A	Rain Shelter	Noncontributing
J8-1959B	Rain Shelter	Noncontributing
J8-1961	Camera Pad A No. 3	Contributing
J8-1961A	Camera Pad 3 Meteorological Tower	Noncontributing
TR1-475	Touchton (Boxcar)	Noncontributing
TR1-476	Touchton (Boxcar)	Noncontributing

**APPENDIX B: Launch Complex 39: Pad A Historic District
Historic Photographs**

Photo B-1. Aerial view of Launch Complex 39A construction, January 14, 1964.
Source: John F. Kennedy Space Center, KSC-64C-0027; accessed via NASA Image Exchange (NIX) at http://nix.nasa.gov/.

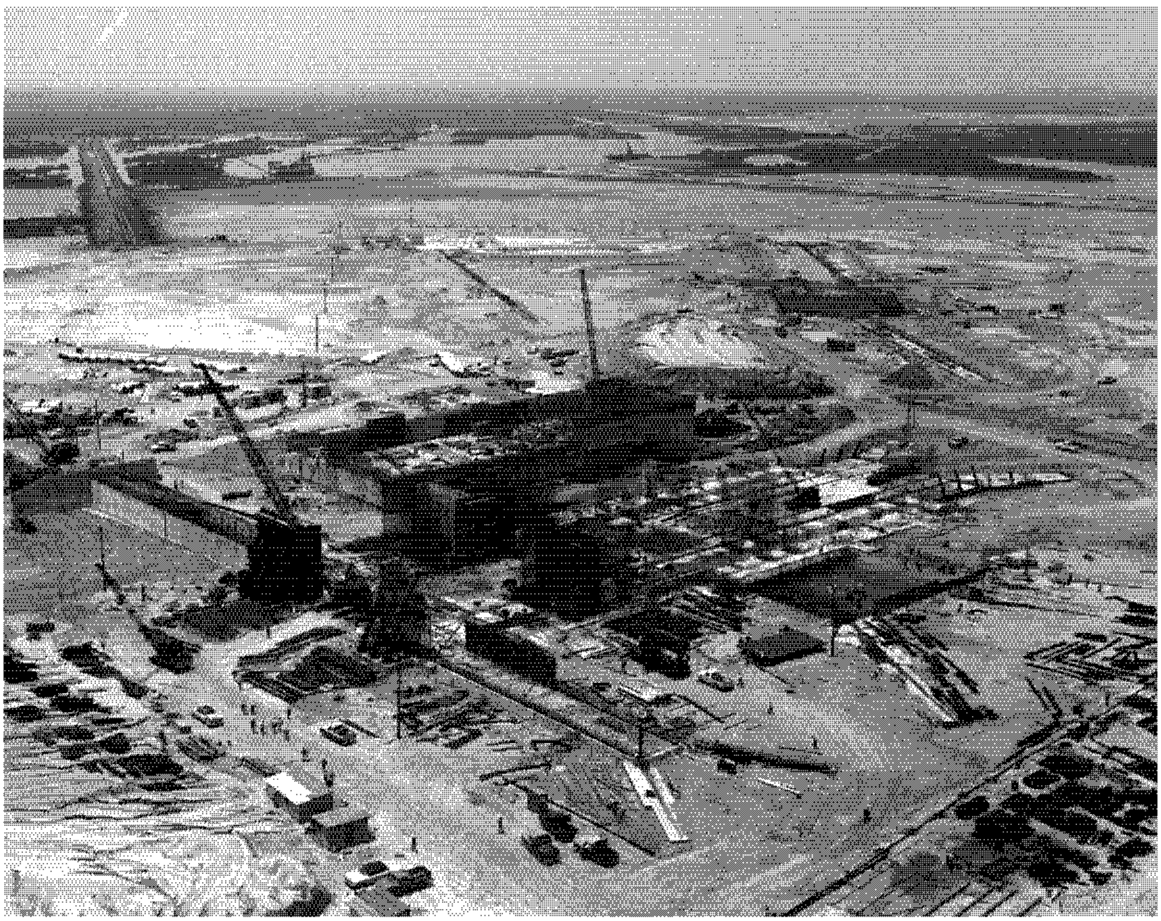

Photo B-2. Aerial view of LC39A hardstand construction, 1964.
Source: John F. Kennedy Space Center, KSC-64C-2980, accessed via NIX at http://nix.nasa.gov/.

Photo B-3. View of LC39A construction, 1965.
Source: John F. Kennedy Space Center, KSC-65C-3018, accessed via NIX at http://nix.nasa.gov/.

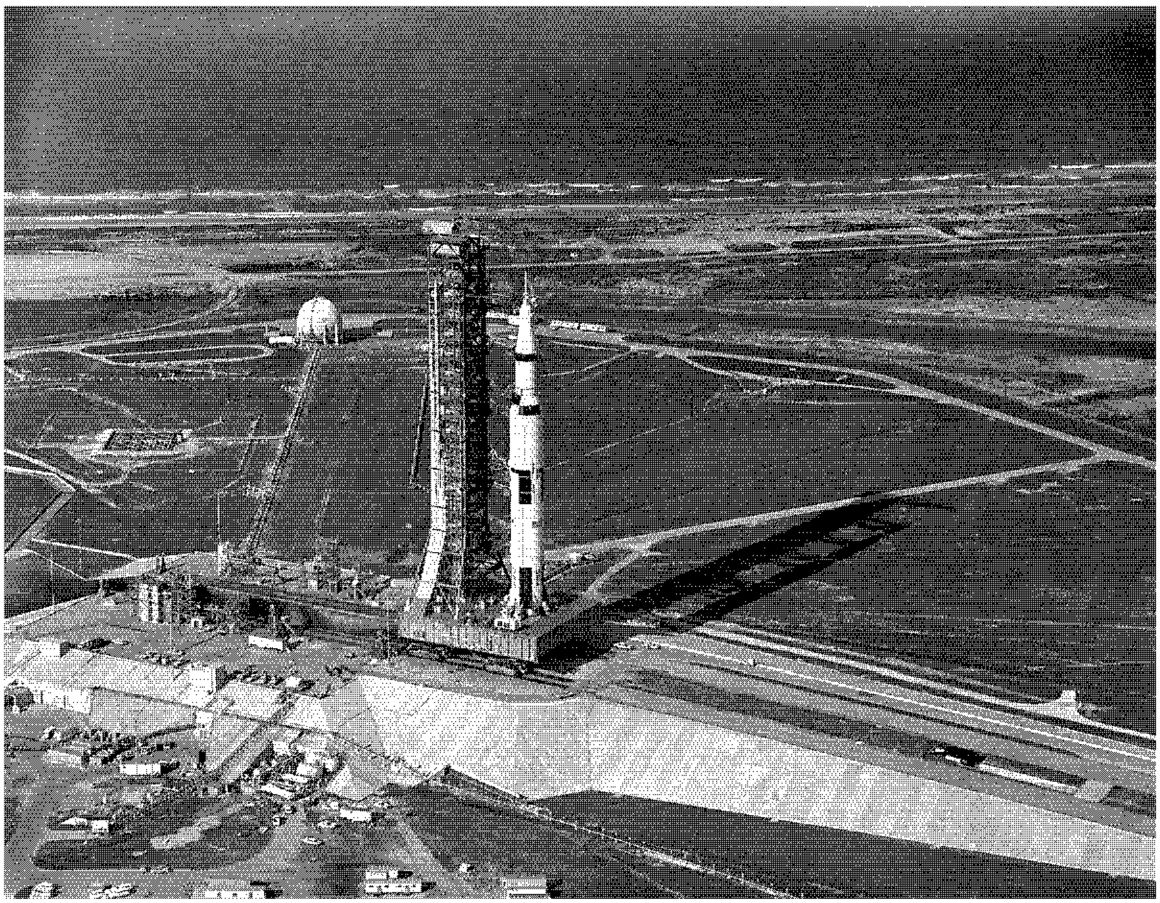

Photo B-4. Apollo 11 arriving at LC39A, April 20, 1969.
Source: John F. Kennedy Space Center, GPN-2000-001850, accessed via NIX at http://nix.nasa.gov/.

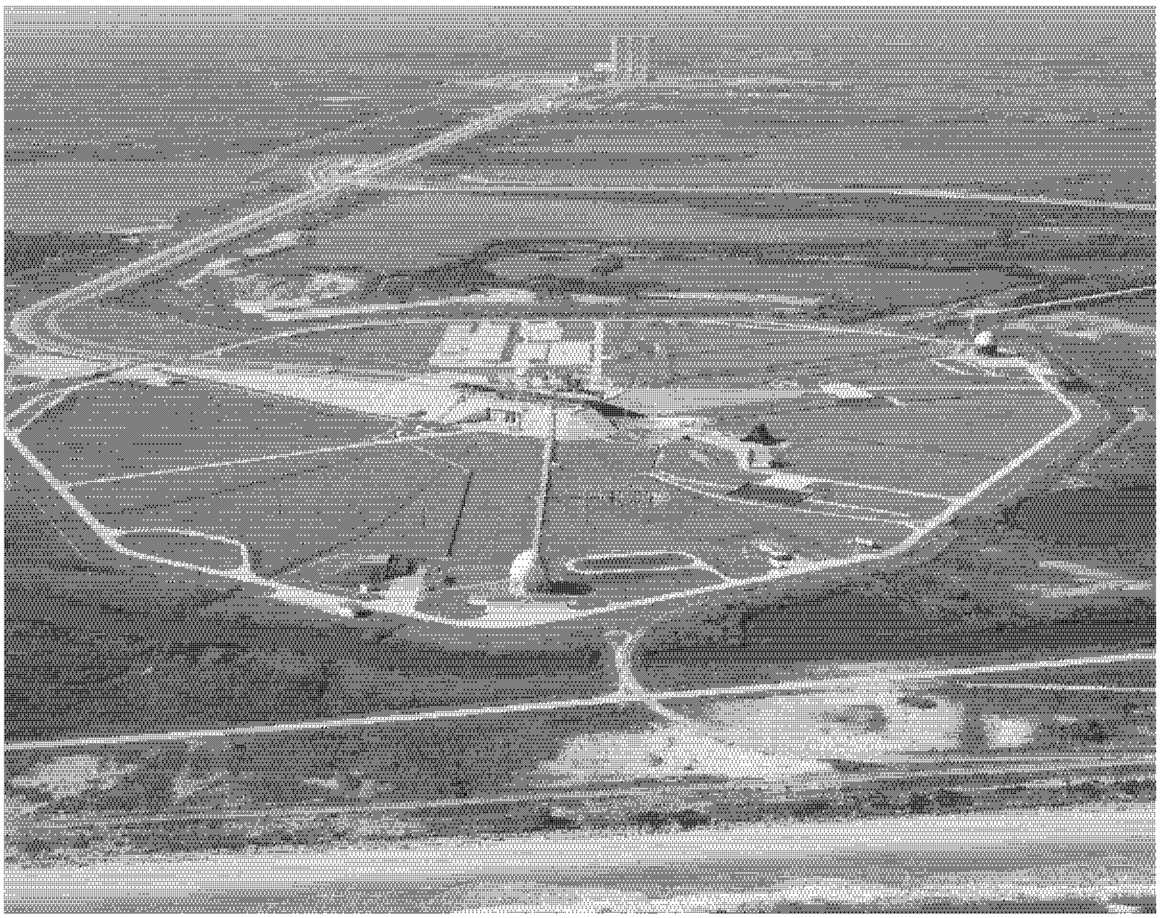

Photo B-5. Aerial view of LC39A, January 1976.
Source: John F. Kennedy Space Center Archives, G-0117.

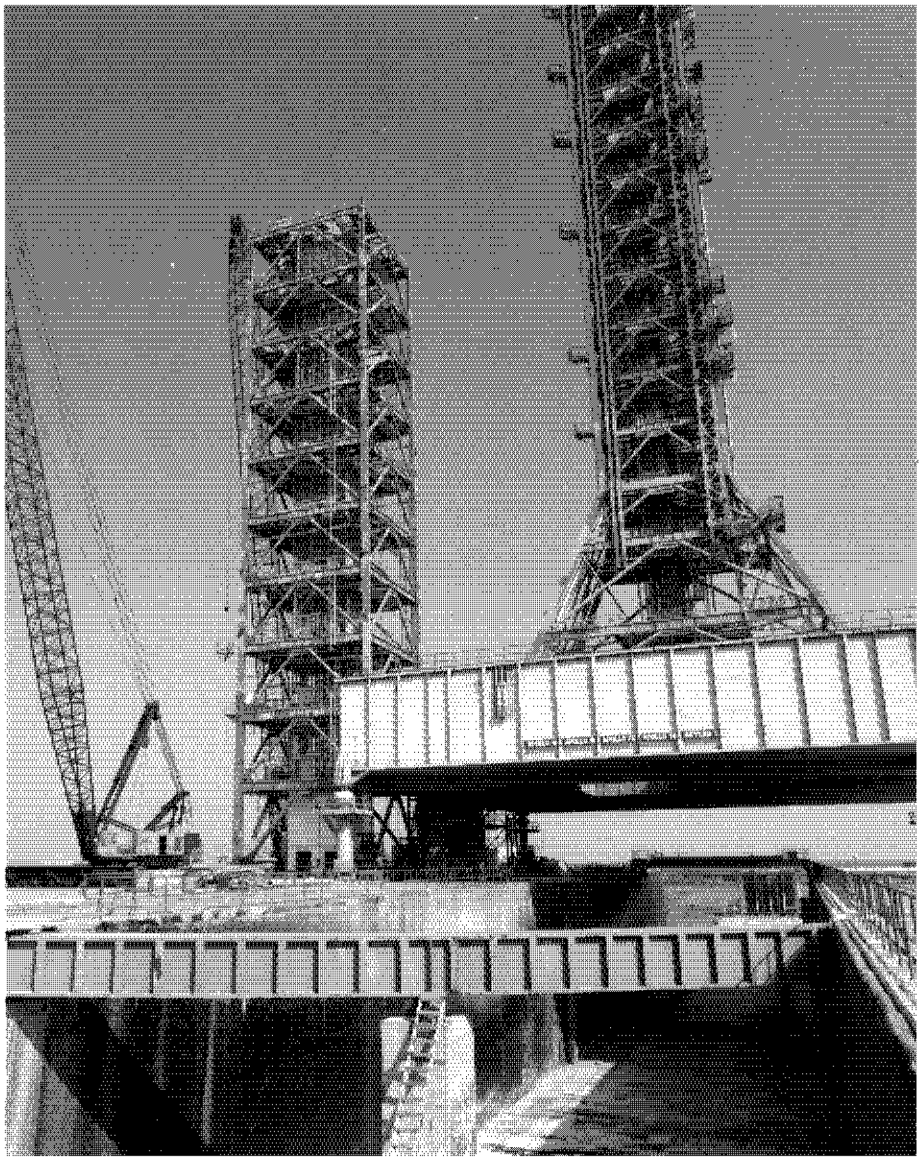

Photo B-6. Fixed Service Structure at LC39A being constructed from Apollo-era Mobile Launcher No. 3, October 5, 1976.
Source: John F. Kennedy Space Center Archives, 108-KSC-76PC-541.

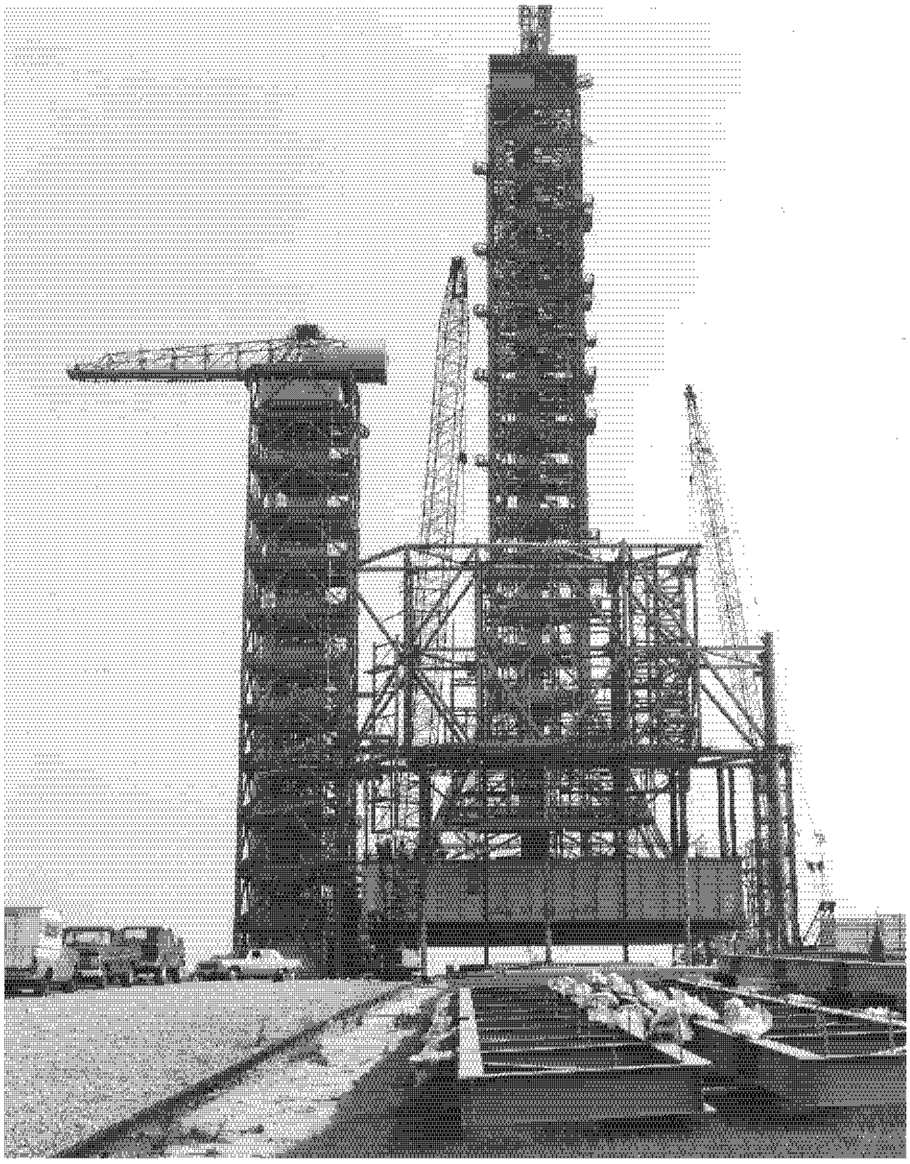

Photo B-7. Construction of the Rotating Service Structure at LC39A, May 23, 1977.
Source: John F. Kennedy Space Center Archives, 108-KSC-77P-160.

Photo B-8. Construction of the Payload Changeout Room at LC39A, September 9, 1977.
Source: John F. Kennedy Space Center Archives, 108-KSC-77PC-311.

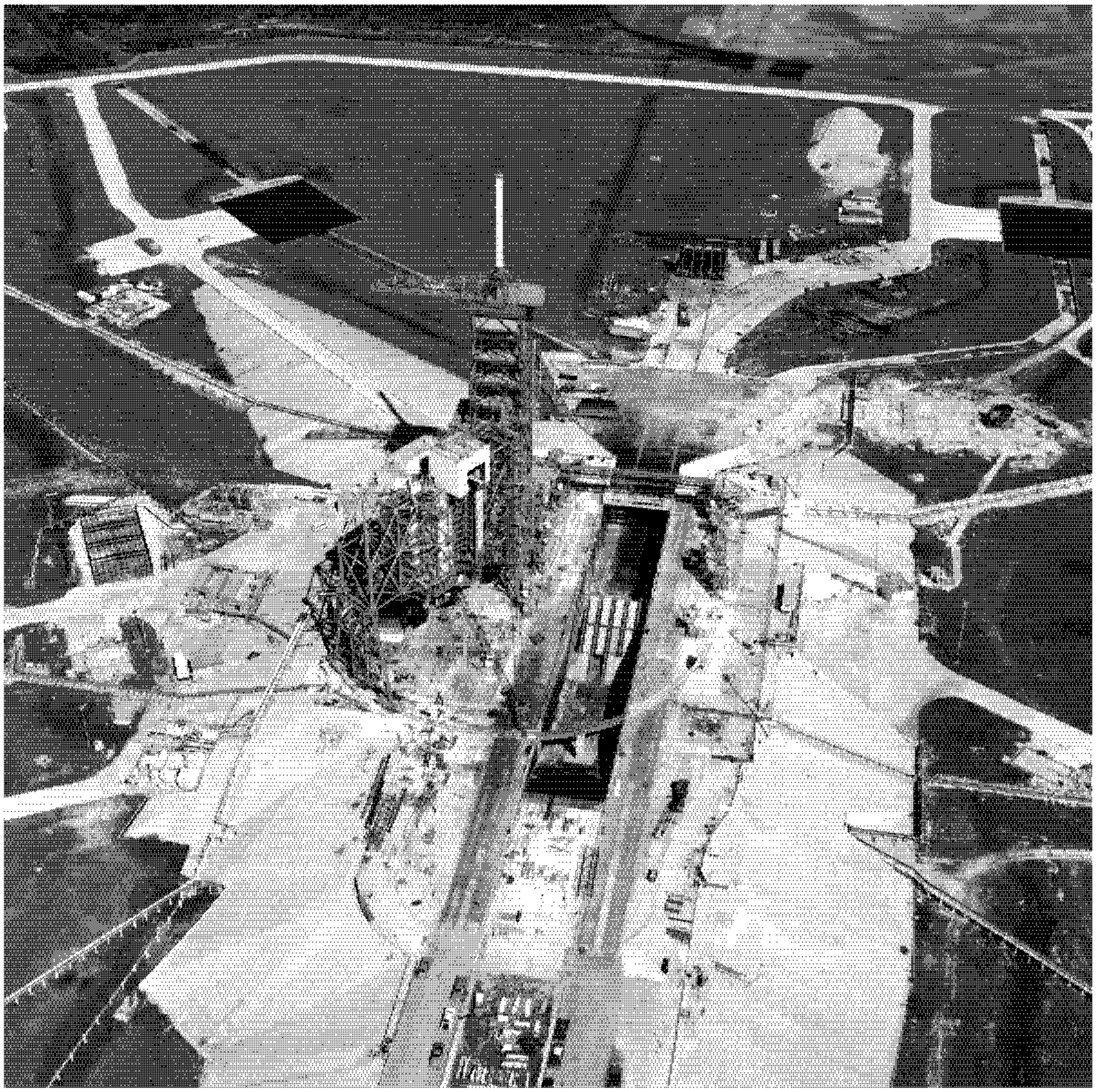

Photo B-9. Aerial view of construction work at LC39A, October 15, 1977.
Source: John F. Kennedy Space Center Archives, 108-KSC-377C-626 Frame 48.

Photo B-10. Construction of the LC39A Sound Suppression System, March 28, 1978.
Source: John F. Kennedy Space Center Archives, 108-KSC-378-298 Frame 4.

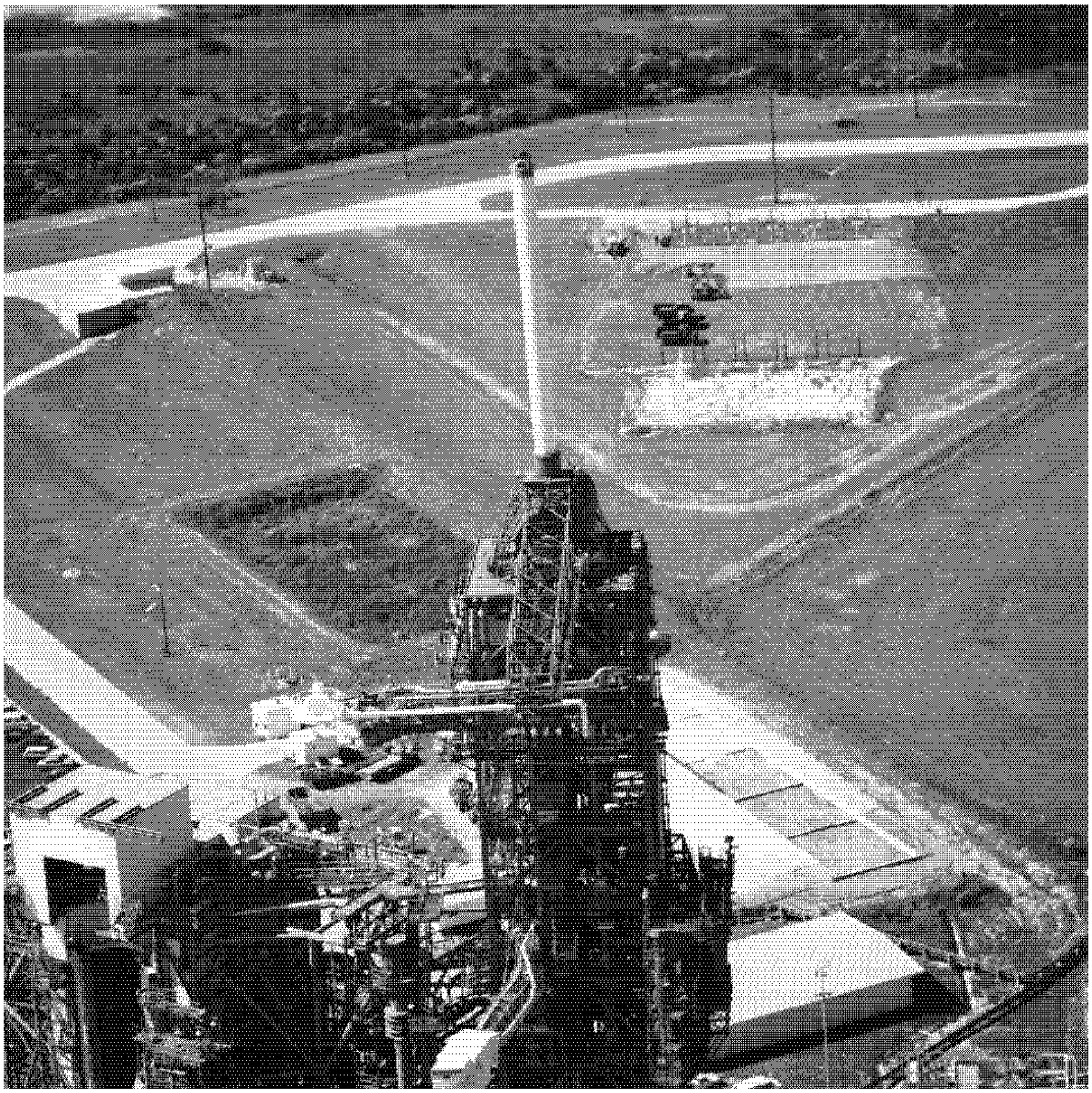

Photo B-11. Construction of the Slidewire Termination Facility at LC39A, November 6, 1980.
Source: John F. Kennedy Space Center Archives, 108-KSC-380C-3034 Frame 5.

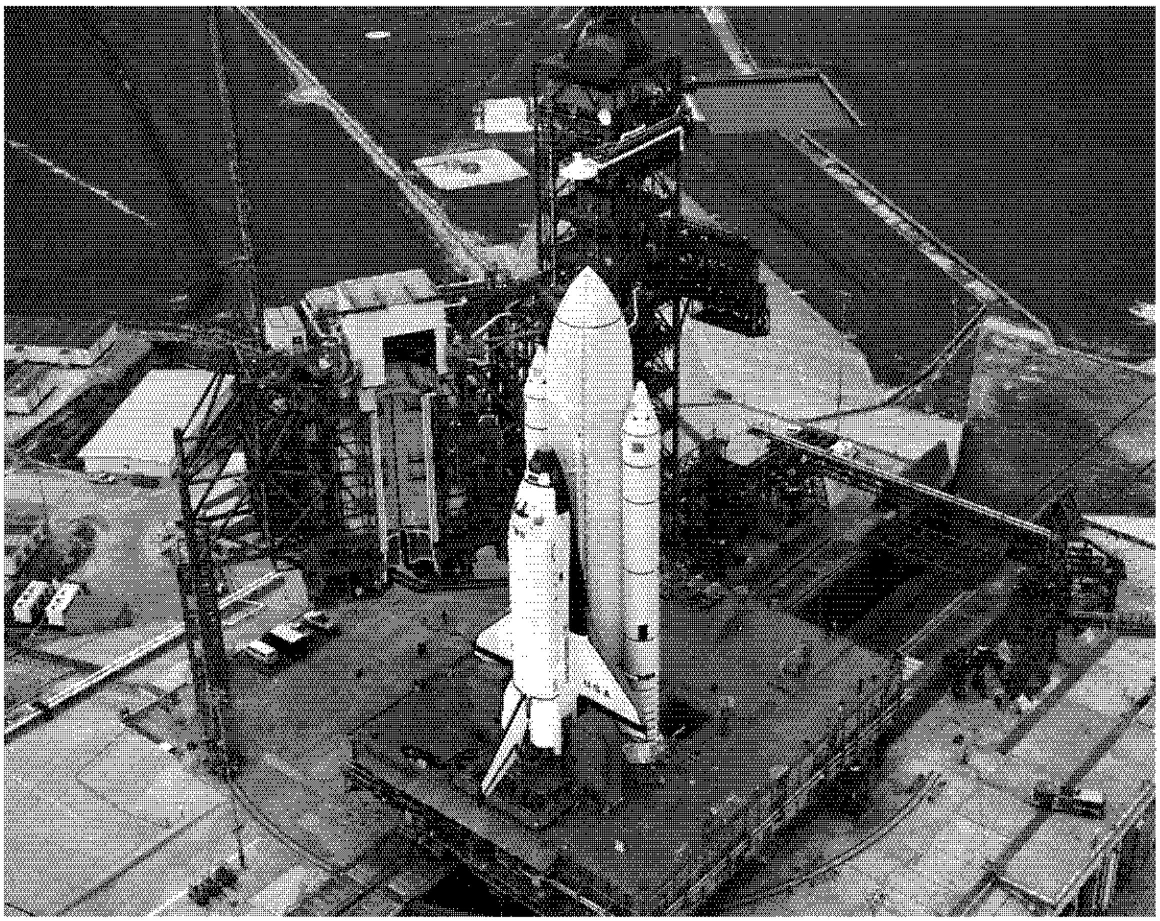

Photo B-12. Arrival of STS-1 at LC39A, December 29, 1980.
Source: John F. Kennedy Space Center, KSC-80PC-0645, accessed via NIX at http://nix.nasa.gov/.

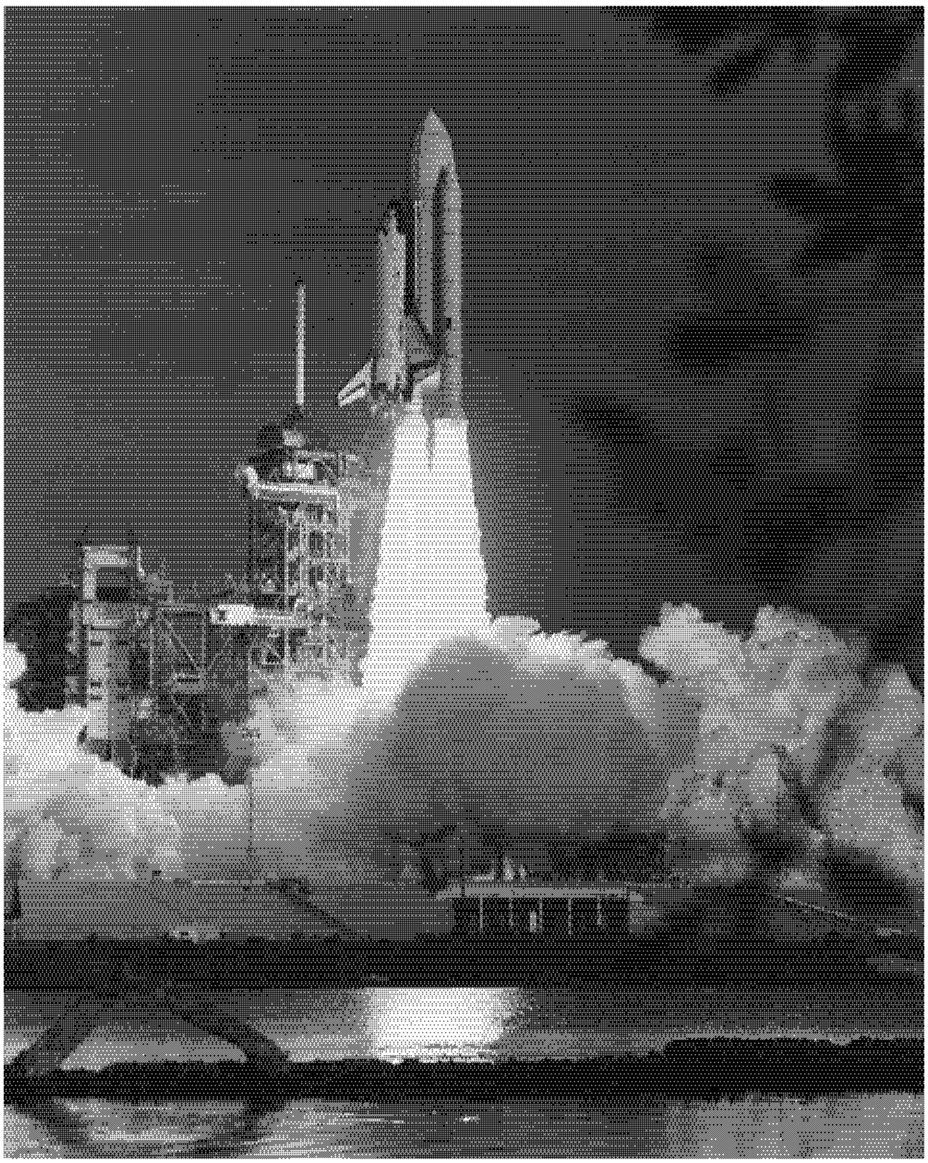

Photo B-13. Launch of STS-1 from LC39A, April 12, 1981.
Source: John F. Kennedy Space Center, KSC-81PC-0371, accessed via NIX at http://nix.nasa.gov/.

Photo B-14. View of various FSS access arms in their extended position, April 17, 2009.
Source: John F. Kennedy Space Center, KSC-2009-2730, accessed via
http://mediaarchive.ksc.nasa.gov/search.cfm.

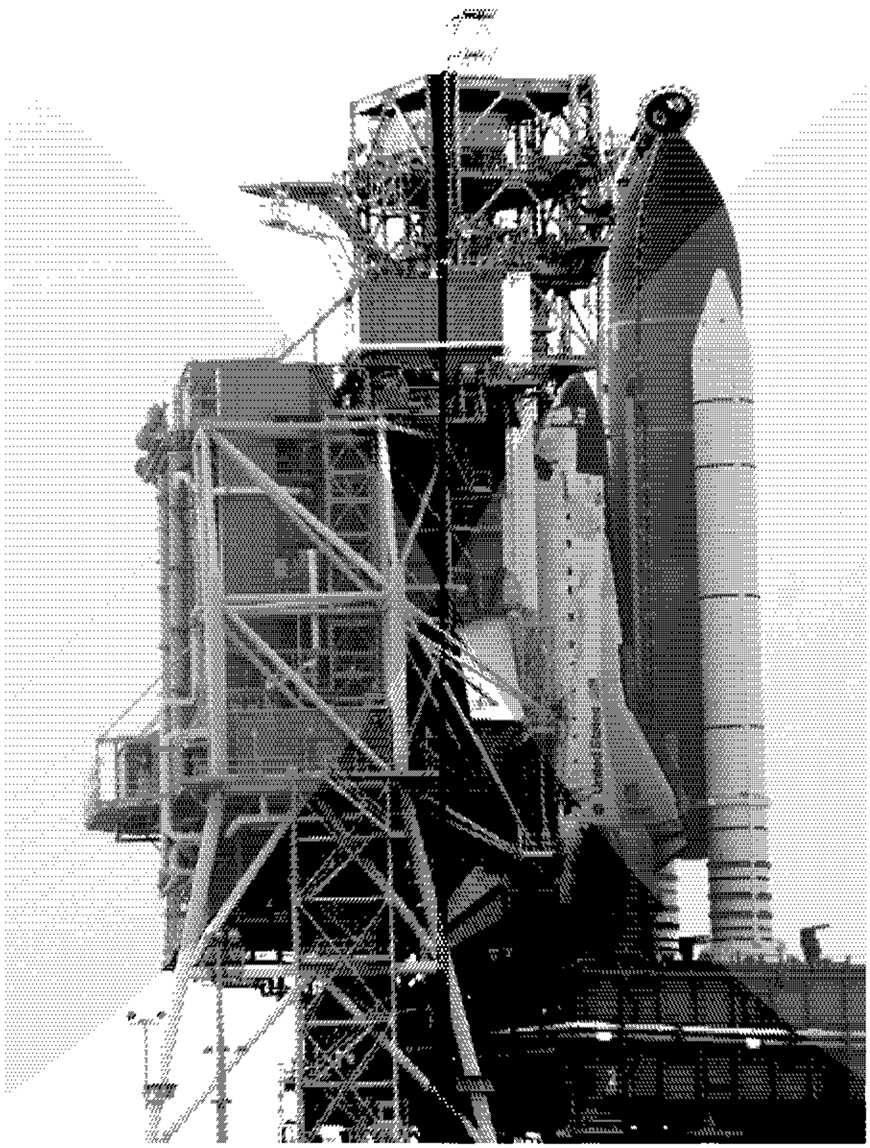

Photo B-15. View of RSS as it moves to its mated position around the orbiter, August 27, 2009.
Source: John F. Kennedy Space Center, KSC-2009-4870, accessed via
http://mediaarchive.ksc.nasa.gov/search.cfm.

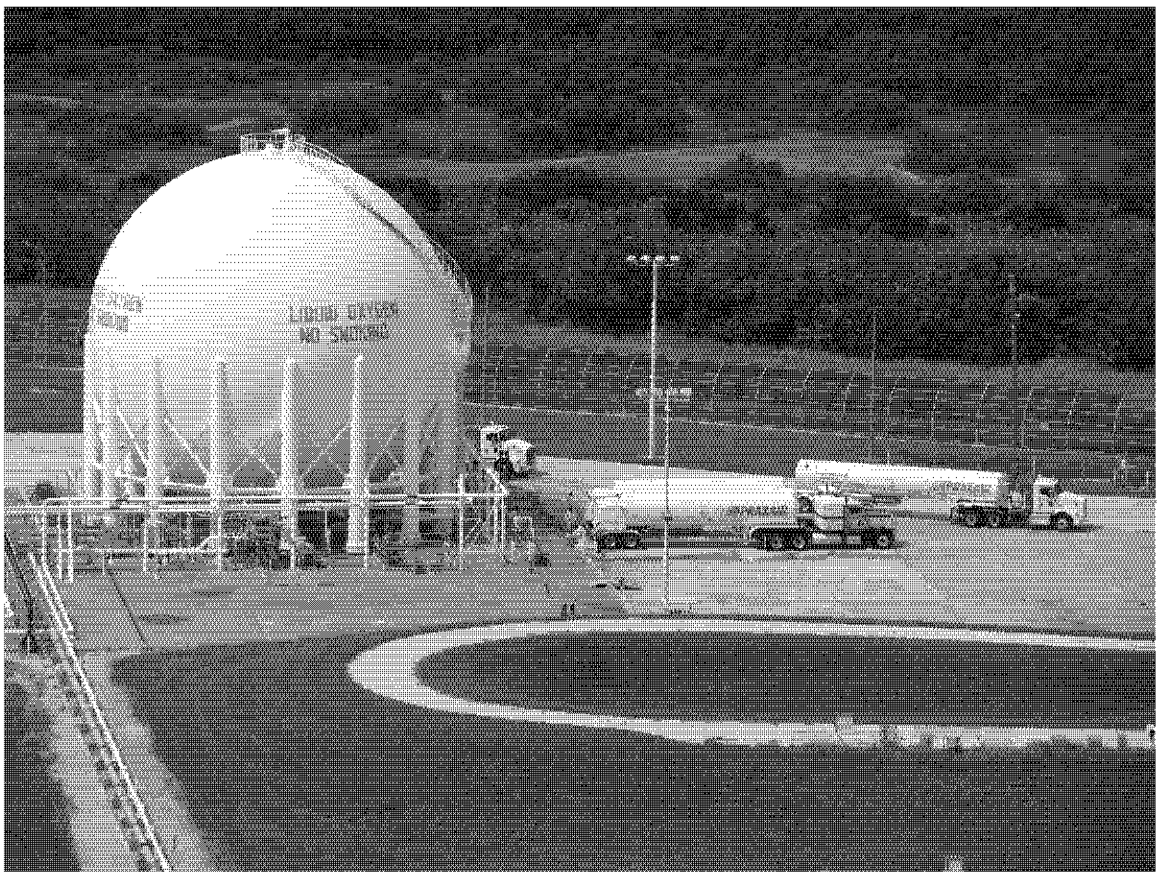

Photo B-16. Tanker trucks in the process of filling the LOX storage tank, October 5, 2009.
Source: Archaeological Consultants, Inc.

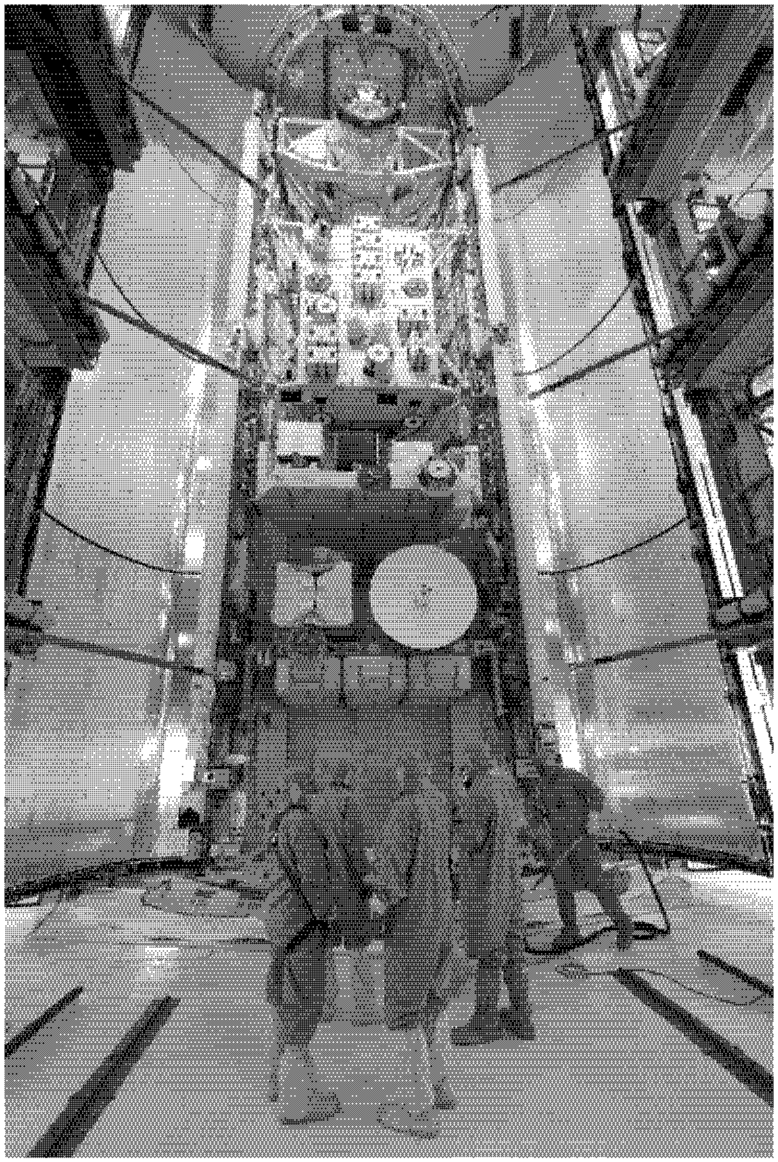

Photo B-17. Preparing to close the orbiter's payload bay doors, June 6, 2009.
Source: John F. Kennedy Space Center, KSC-2009-3564, accessed via
http://mediaarchive.ksc.nasa.gov/search.cfm.

APPENDIX C: Launch Complex 39: Pad B

Introduction:

The "Missile Launch Complex 39 Site," which included Launch Complex 39B, was originally listed in the NRHP on May 24, 1973 for its association with the Man in Space Program. This historic property was reevaluated in 1996 in the context of the Apollo Program, ca. 1961 through 1975, and on January 21, 2000 the newly defined Launch Complex 39: Pad B Historic District was listed in the NRHP. Per this nomination, the historic district contained twenty-three contributing and thirty-four noncontributing resources within its boundary. The Launch Complex 39: Pad B Historic District has since gained importance in the context of the Space Shuttle Program, circa 1969 to 2010. As currently defined, the historic district contains twenty-one contributing resources and twenty-four noncontributing resources within its boundary.

As noted on Page 2 of this report, there are only two sites at KSC that have been used during the Space Shuttle Program: Launch Complex 39: Pad A and Launch Complex 39: Pad B. Per the "Programmatic Agreement among the National Aeronautics and Space Administration John F. Kennedy Space Center, Advisory Council on Historic Preservation, and the Florida State Historic Preservation Officer regarding Management of Historic Properties at the Kennedy Space Center, Florida," if there are multiple assets of a specific property type that are 95 percent identical, only one of the assets will be recorded, in this case, Launch Complex 39: Pad A. Since these launch complexes were essential to the Space Shuttle Program, this appendix has been included as part of this documentation package to provide a brief summary of the history of Launch Complex 39: Pad B (LC39B) and note any major physical differences.

Historical Information:

The drawings for the original LC39B were completed by Giffels and Rosetti, Inc. of Detroit, Michigan, in October 1964; construction of the complex, by the George A. Fuller Company headquartered in New York, New York, was completed in 1968. An exact replica of LC39A, the complex consisted of the launch pad, fuel and oxidizer facilities, camera stations, electrical equipment buildings, a water chiller facility, an emergency egress facility, and operations offices. The first launch from LC39B, and its only one during the Apollo Program, was Apollo 10, which lifted off on May 18, 1969. The complex was later used to launch the three manned missions of the Skylab program (May 25, 1973 [Photo C-1], July 28, 1973, and November 16, 1973), as well as the Apollo-Soyuz Test Project mission (July 15, 1975).

In June 1977, Reynolds, Smith and Hills of Jacksonville, Florida, was awarded a contract to provide specifications and drawings for modifications to Pad B, which were completed by December 1978. On August 11, 1978, the Frank Briscoe Company, Inc. of East Orange, New Jersey, was awarded a $17.2 million contract to complete the initial work at LC39B, which included the erection of the FSS using the Apollo-era Launch Umbilical Tower; the rail track to allow the RSS to move back and forth; and the sound suppression system.[1] On October 8, 1980, a $6.7 million contract was awarded to W&J Construction Corporation of Cocoa for installation of the ground support equipment within the Pad B complex, including the installation of pipes and cable to carry fuels, fluids, and air to the FSS and RSS.[2] Additional work at LC39B was completed by Saver Mechanical, Inc. of Jacksonville, Florida, and the Holloway Corporation of Titusville, Florida.[3] Space Shuttle program modifications within the LC 39: Pad B complex were completed in late 1985.

On January 28, 1986, the *Challenger* was the first Space Shuttle to lift off from LC39B (Photo C-2). Seventy-three seconds after launch, this mission abruptly ended with a failure in the right SRB O-ring, which caused the loss of the spacecraft, as well as the entire crew. In the aftermath of the *Challenger* accident, LC39B was put into inactive status to allow time for modifications that included new weather protection structures, a SRB joint heater to keep the field joints at 75 degrees, freeze protection for the water systems, debris traps, and temperature and humidity control improvements for the PCR. With the resumption of Space Shuttle flights, LC39B became the principle launch pad, with the first Return to Flight mission that lifted off on September 29, 1988 (Photo C-3).

LC39B launched the following six missions, which occurred between December 1988, and November 1989, while LC39A was on inactive status for modifications. Between 1990 and 2003, the two launch complexes were used jointly, with thirty-eight missions lifting-off from LC39B and forty from LC39A.[4] Highlights from those missions that launched from LC39B include the deployment of the Hubble Space Telescope (STS-31, April 18, 1990) and its first servicing mission (STS-61, December 1, 1993); the Gamma Ray Observatory deployment and first spacewalk in five years (STS-37, April 5, 1991); the first flight of the Orbiter *Endeavour* (STS-49, May 7, 1992); and John Glenn's return to space (STS-95, October 29, 1998).

On July 26, 2005, the second Return to Flight mission, which followed the loss of *Columbia* in February 2003, lifted-off from LC39B. The next three flights were also launched from this complex; on December 9, 2006, STS-116 became the final Space Shuttle mission to lift-off from LC39B.[5] In 2007, work began on the complex to renovate it for the test flight of Ares I-X (Photos C-4 and C-5), which occurred on October 28, 2009.

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[1] Frank E. Jarrett. "Chronology of KSC and KSC Related Events for 1978." KHR-4, January 1, 1980, 58.
[2] Ken Nail, Jr. and Elaine Liston. "Chronology of KSC and KSC Related Events for 1980." KHR-5, March 1, 1981, 223.
[3] Ken Nail, Jr. "Chronology of KSC and KSC Related Events for 1983." KHR-8, October 1, 1984, 60; Ken Nail, Jr. "Chronology of KSC and KSC Related Events for 1984." KHR-9, June 1985, 93.
[4] In June 1991, LC 39B was again placed on inactive status to allow for a six-month period of repairs and refurbishment. It was reactivated in 1992 for the launch of STS-49 in May.
[5] Jenkins 294-295, 302-303, 310-311; NASA. "Space Shuttle Mission Archives." February 2010; NASA. "NASA's Shuttle and Rocket Launch Schedule." March 26, 2010. In April 2009, LC39B hosted Space Shuttle Endeavour (STS-400) as a contingency in the event of a problem with STS-125's visit to the Hubble Space Telescope.

Physical Differences of LC39B

There are very few physical differences between LC39A and LC39B. The major difference between the two complexes is that LC39B sits 7' higher above mean sea level than LC39A. Another difference is the inclusion of an additional access road to the northwest reclamation pond. At the time of this documentation, two modifications had been made to LC39B, including the installation of a vehicle stabilization arm at the 235' Level of the FSS and the replacement of the lighting mast at the top of the FSS with three towers located throughout the complex.

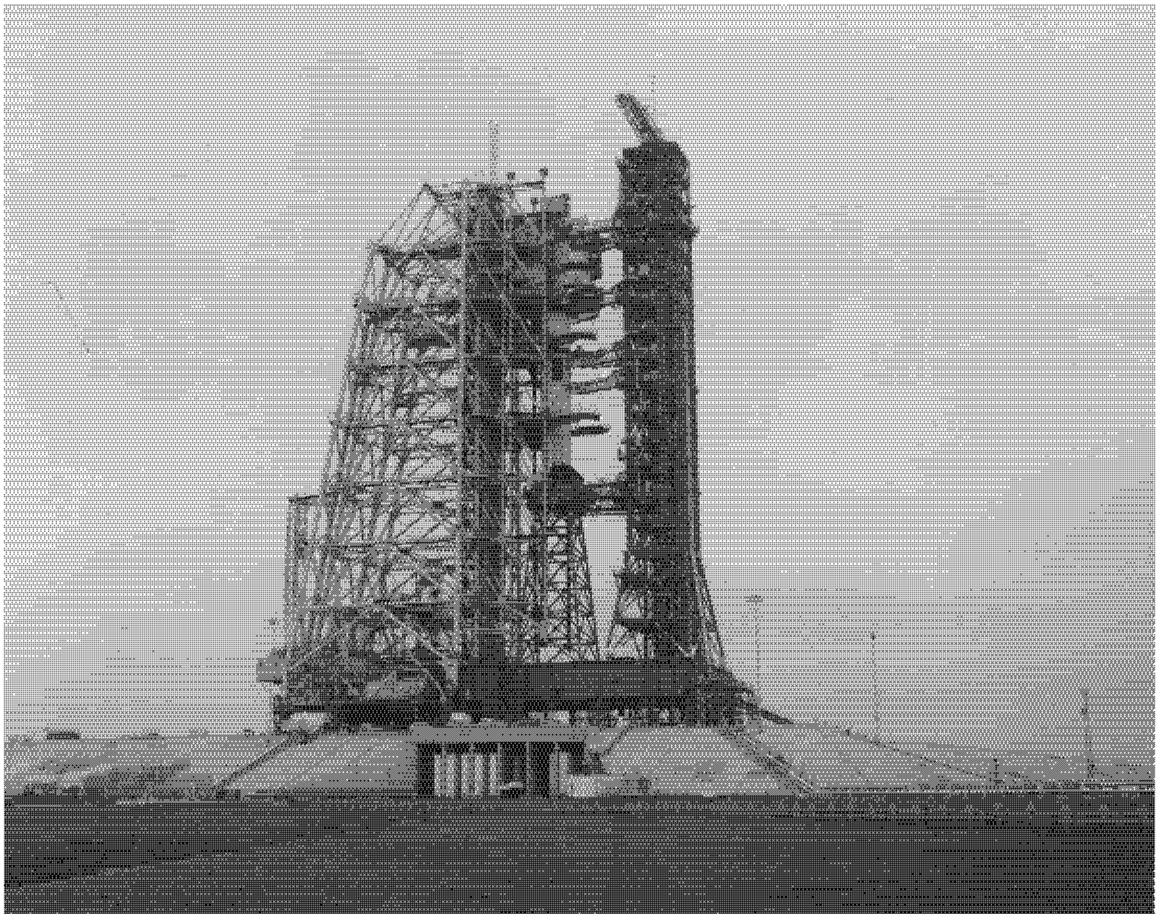

Photo C-1. View of Skylab 2 at Launch Complex 39B, January 11, 1973.
Source: John F. Kennedy Space Center, KSC-73PC-0017; accessed via NASA Image Exchange (NIX) at http://nix.nasa.gov/.

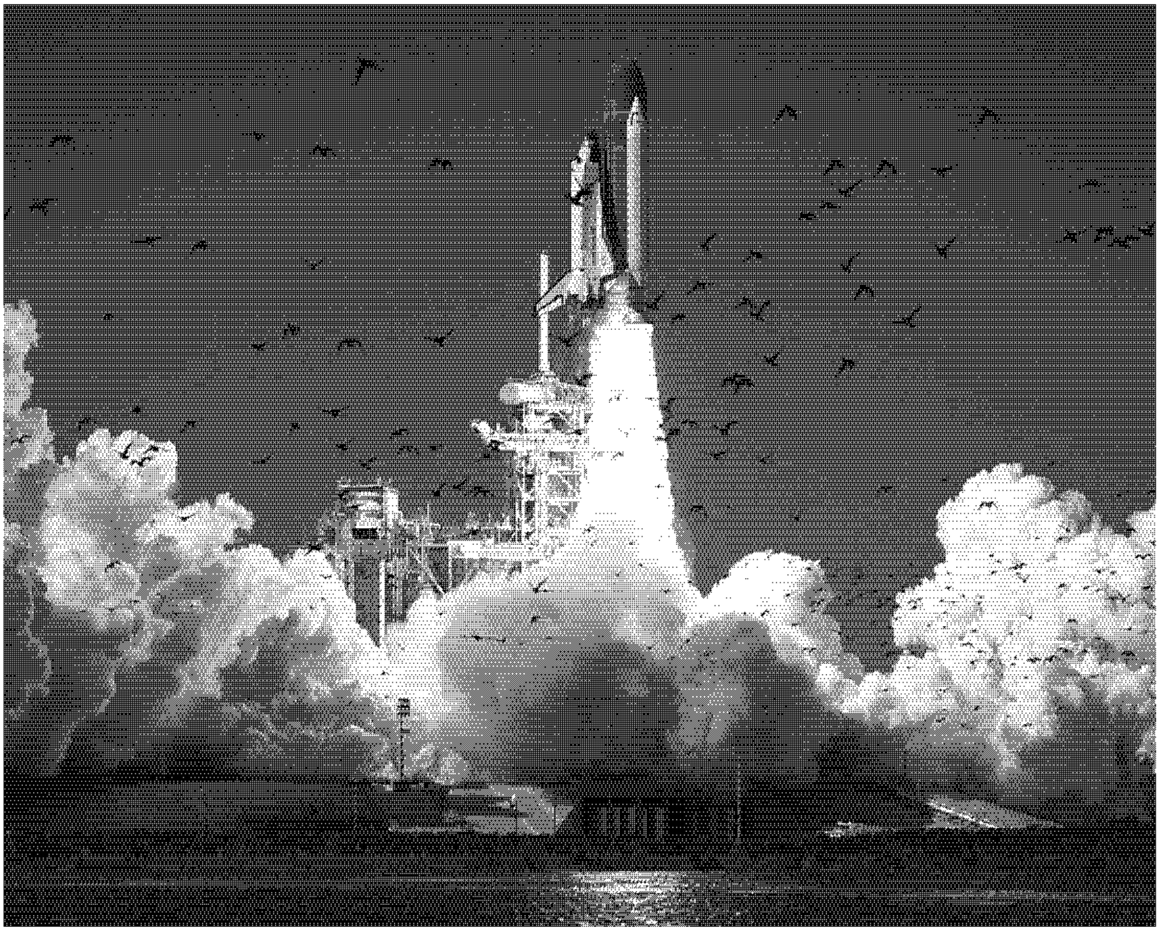

Photo C-2. Launch of STS-33, *Challenger*, the first Space Shuttle mission to lift off from LC39B, January 28, 1986.
Source: John F. Kennedy Space Center, KSC-86PC-0081; accessed via NIX at http://nix.nasa.gov/.

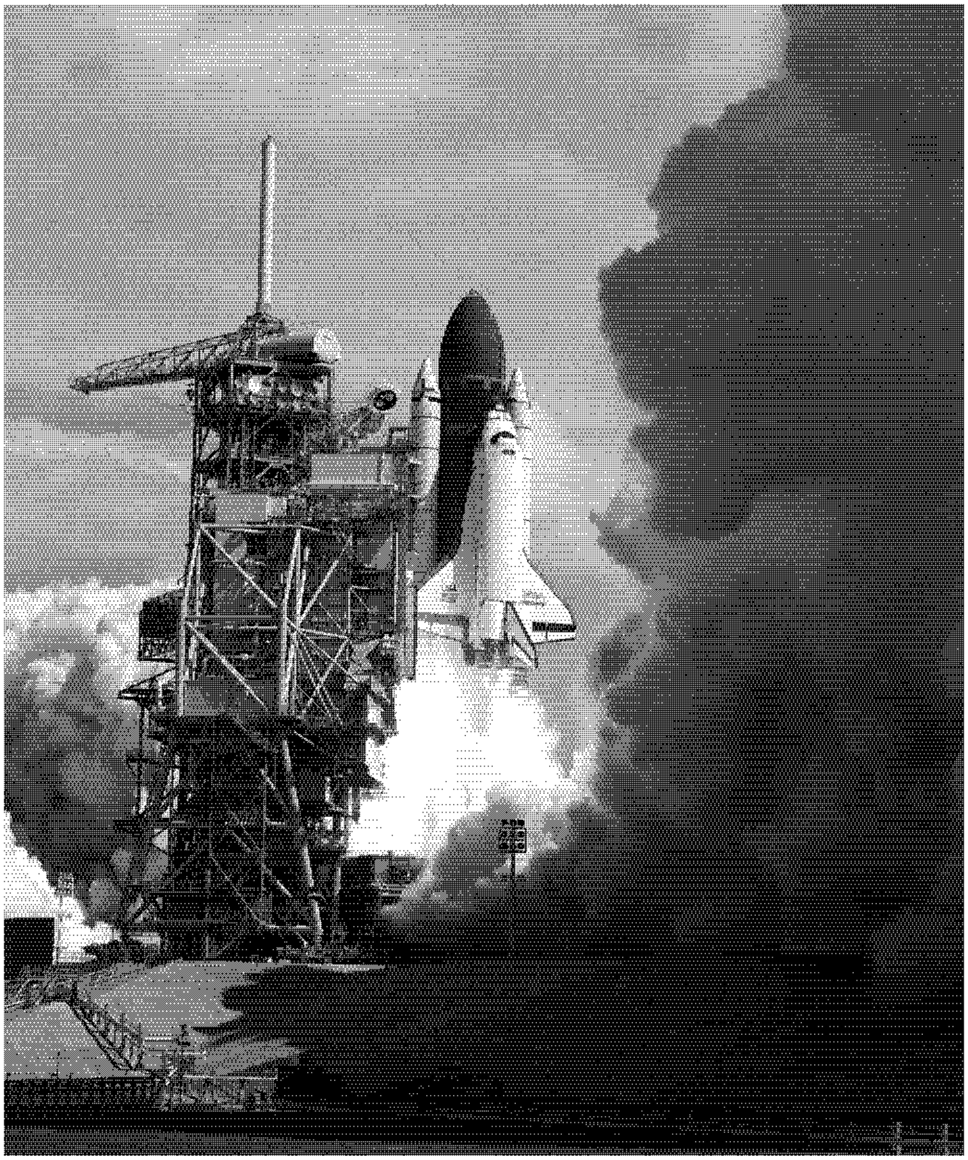

Photo C-3. Launch of STS-26, *Discovery* from LC39B, for the "Return to Flight" after the *Challenger* accident, September 29, 1988.
Source: Langley Research Center, EL-1997-00011; accessed via NIX at http://nix.nasa.gov/.

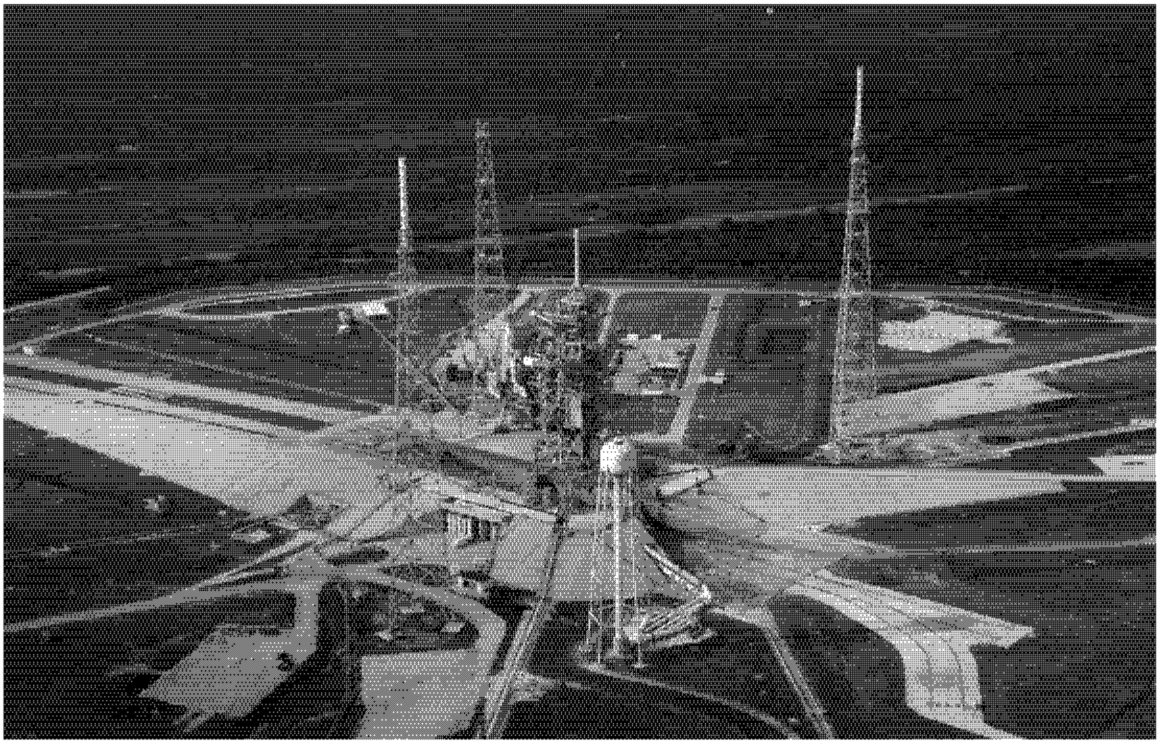

Photo C-4. LC39B during the installation of the new lightning protection system, February 12, 2009.
Source: John F. Kennedy Space Center, KSC-2009-1572; accessed via http://mediaarchive.ksc.nasa.gov/.

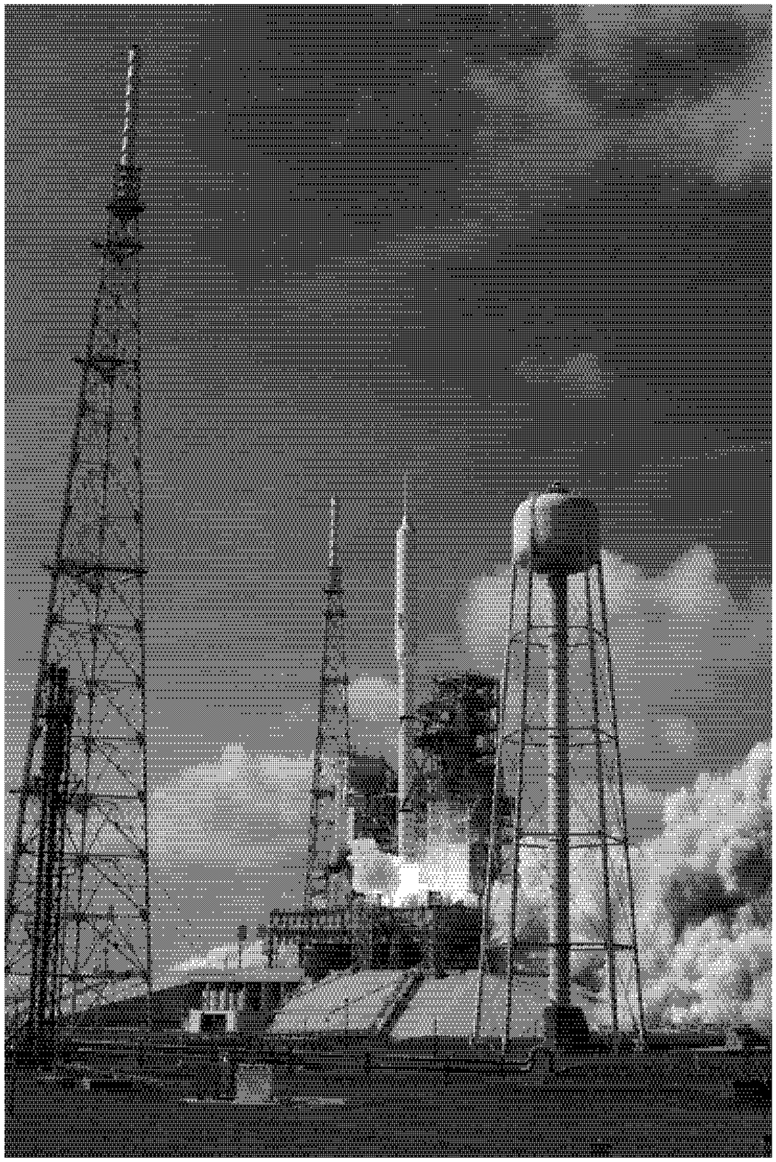

Photo C-5. Launch of the Ares I-X test flight from LC39B, October 28, 2009.
Source: John F. Kennedy Space Center, KSC-2009-5974; accessed via
http://mediaarchive.ksc.nasa.gov.